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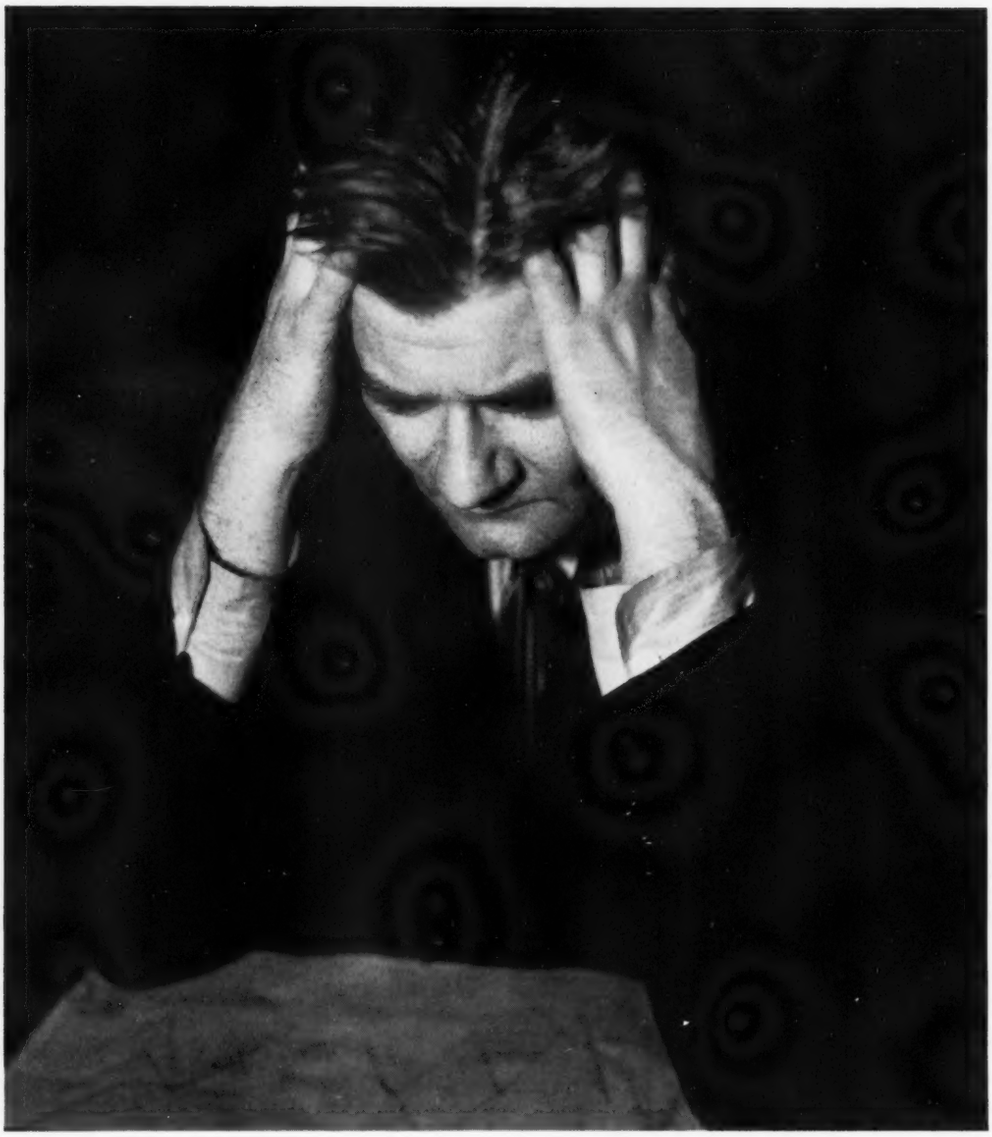

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ELECTRICAL WORLD

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What in the World!

There is at least the element of a grim jest in the action of McCook, Neb., which has just voted down a municipal power project. Jest lies in the fact that McCook should be the home town of that high priest of public ownership Senator George W. Norris. Verily, a prophet is not without honor but in his own country and among his own kin.

●

Norris appears to be achieving a far more significant outcome, however, in his battle for the Johnson bill, that federal measure which would preclude appeal to the courts from commission rulings. Washington predicts enactment before long.

●

Thoroughly outraged, a subscriber with refuge in anonymity, takes us to task for asserting, however guardedly, in recent weeks that business skies are clearing. To the substantiating facts which accompany our weekly observations he remains completely blind because his employer, the No-Matter-Which Company, is in dire straits. That is one of the problems of an editor. How to eliminate the close-up view of the trees so that the reader may see the forest.

●

We like the case study in this issue which shows just what the refrigerator and range loads mean to utility and to consumer in the case of individual customers. Loads and revenue go up; rates go down. Everybody ought to be pleased. Never a better time to get out and sell the load than right now.

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February 24, 1934

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L. W. W. MORROW, *Editor*

Power as a Social Ideal

MEN of the electrical industry watch with wonder and concern the continuing evidences that the government is going deeper and deeper into the power business. Muscle Shoals, Boulder Dam, Columbia, St. Lawrence, one after the other has shown the trend. Now in the Tennessee Valley the administration is setting up a service to cities and has announced a program for developing the domestic market for appliances. And the man who has watched the ill success of municipal power operation in this country and come to feel that government in business does not work is naturally perplexed. He can only understand it when he begins to realize that power has become part of a broad social ideal, in which Washington is increasingly interested.

A thousand years ago national governments recognized few responsibilities for public service. The first was national defense. Then police, education, health, mail, roads, coast guard and other activities have followed in varied sequence. Among them in this country is jurisdiction over inland waterways. And public sentiment and political opinion is gaining that flood control and irrigation and navigation should be developed to the utmost. The people in the valleys should be safeguarded. Lands made fertile by water supply should be enjoyed by families now struggling on exhausted soils. Cheaper transportation should be employed whenever boats will better the railroads. It all makes an appealing picture, particularly when you remember that river improvement means dams and dams bring water power. So water power has become a thing with which to conjure.

Now, as every electrical man understands, hydro developments are usually far away from cities and power can be made from steam today as cheaply as from water. But power in this broad program is a byproduct, and this fact is dominating the planning for this social ideal. For the promoters of this program say, "Why not, then, capitalize this byproduct, this power, at half its cost, reduce the price of power service proportionately and see what public benefit will come of it?"

THE cost of power in a pair of shoes, a suit of clothes, a motor car, they know, is not enough to matter much. But with this cheaper power, they argue, what new industrial processes now uneconomic might come within reach? Electric heat, for instance—would it permit a new control and regulation in some industrial processes that might result in fifty times the saving in the cheaper power? And in domestic use, would service at a cent, we'll say, improve the living standards of more millions and, by freeing woman's time, by labor saving, perhaps lift her to a new status in the social economics of our civilization?

A search is now being made for new industrial ideas that have been developed within the past ten years and laid aside because of cost. It is the hope of these idealists that cheap power

may impulse another forward surge of social progress, such as the building of the railroads and the development of the automobile and good roads contributed. And wise or foolish, practical or visionary, right or wrong, this is the dream that is now driving forward the federal power program of which one hears so much.

That all this may jeopardize the vested interests of the great power industry and the savings of many millions of security holders is not allowed to interfere with what appears to them to be the greater public interest.

New thinking from the San Joaquin

About a year ago the street railway in Bakersfield, Calif., let the public ride free during certain hours of the day. A lot of people got the habit and kept on riding when the five-cent fare was resumed. Acting on this experience, the San Joaquin Light & Power Corporation, which owns the Bakersfield railway, is now going to try the same idea on domestic and commercial customers of both the San Joaquin and Midland Counties systems. During April and May these consumers can use all the electricity they want for the same bill they paid in March and they can take advantage of the extra consumption to qualify under a lower rate. As President Emory Wishon puts it, "We are going to use a temporary surplus of power to break the popular habit of economizing with electricity." Southern Sierras Power Company, not connected with the properties mentioned, has a similar plan of less broad scope.

Due to seasonal high water and decreased load, the company has excess power going to waste. Business is on the decline and earnings are less than was contemplated when rate reductions were made in 1932. To avoid drastic reductions of income, the customer is now offered more for his money, in the belief that this inducement will result in many range, water heater and refrigeration installations that would not otherwise be made. For two months service without charge will equal 16 2/3 per cent saving on the annual cost of operating a range and might well move many a family to buy now. And the liberal enjoyment of the service for this period may put an end to the skimping in the use of current that has developed in many homes, stores and offices throughout the past three years.

We are emerging from a depression and the spirit of change is in the air. New ideas are needed to meet new attitudes. The greatest menace that the power industry faces today is not political attack, but the hazard that confronts all business men in this perplexing period—the danger that it will not have the initiative and courage to turn its back on old methods and traditions and seek the new pathways that lead up to the hills. The most vital need will be new commercial policy, new thinking on market development that will open the door to a much larger domestic consumption of electricity by all consumers.

Therefore this innovation in the San Joaquin Valley is of particular interest and will be watched throughout the country. It introduces a novel merchandising method as a new approach to the problem of increasing residence load. The results may indicate something of importance.

Highway safety lighting a logical "public works"

Inevitable it was that the administration effort to create public works and civil works jobs should have led into a number of warmly criticised enterprises. Regardless of these commitments and regardless of the closing of the books against new proposals, good or bad, there is one that should still receive respectful and eager attention. Hundreds of miles of arterial and interurban highways should be lighted with some public funds as their inspirational support and the whole made a meritorious investment devoted to future safety of travel. New roads and new bridges are being built with present traffic not always demanding them. But traffic casualties on existing roads are appallingly costly. Spending capital goods money now to make these routes safe would constitute a self-liquidating investment of the highest humanitarian character.

Time and again it has been proved that light makes handsomely for safety in city streets and the same is being demonstrated for the open highways. With no hesitancy for fear that the

government would immediately sense this move as favorable to utility load, the industry should set this proposal in motion as fast as technically justifiable. It would make work for line construction gangs; for pole, wire and line hardware producers, lighting fixture manufacturers and the makers of electrical equipment generally. Europe has gone extensively to vapor lighting on highways and we are increasing installations here. Efficiency is high and the vapor lamp gives a light that affords high visual acuity at relatively low illumination intensities.

There is another point. Traffic authorities have never completely solved the problem of regulating traffic speed. Installation of surface illumination on the more heavily traveled roads would give a fine opportunity to apply to them a progressive system of traffic lights that would as effectually check speeding as it does on the boulevards. Four-lane roads could have separate signal systems for each lane, affording two levels of speed in each direction and thus approximate the safe dispatching of traffic of the four-track railroads. Poles and power circuits for the surface illumination would serve the dual purpose of safety lighting and safety traffic control and meet the new future of roadway lighting.

Inflexibility handicaps many isolated plants

Industrial plants considering the installation of isolated power generating units run considerable risk of over or under investment in such machinery in cases where the business of the concern fluctuates widely from year to year. In discussing Diesel engine applications before the Plant Engineers Club of Boston, J. C. Wattles of the Boston Edison Company cited several instances of varying peaks and energy consumptions among industrial customers who have found purchased power far more flexible in relation to their needs than independent generation promises in the light of recent experience. The demand of a large rubber company fell from 8,500 kw. in 1928 to 6,000 kw. in 1932, the energy taken dropping from 45,000,000 to 19,000,000 kw.-hr. A steel product maker took 1,400 kw. in 1924, 3,150 kw. in 1930 and only 827 kw. in 1932, the corresponding energy consumptions being 4.4, 8.7 and 1.9 millions of kilowatt-hours. Another manufacturer's demand rose from 450 to 750 kw. and his energy input from 500,000 to 700,000 kw.-hr. per year during the depression. Load factors varied all over the lot among these concerns. The proper capacity and consumptions to use in comparing the cost of central station service with Diesels clearly present a difficult problem.

The engine salesman might advise installing units for handling the loads at the time of purchase, adding units as the demand increases, but this does not meet the situation when the load drops off. The utility or the customer must provide adequate feeder and transformer capacity in any event. It is less costly in general to absorb load fluctuations in substation investment than in isolated prime movers, and back of the substation the power has a diversity advantage that reaches through to the generating station fuel supply or forebay. Idle capacity in transformer and switching equipment in an industrial substation puts less economic pressure on the scheme of power supply than does overcapacity in isolated plant boilers, prime movers and auxiliary equipment. As the uses of central-station energy in industry increase, this diversity advantage grows by leaps and bounds, and the customer can cast the burden of fluctuating demands upon his substation and the power company serving it.

In measuring the peak load to be carried either by isolated prime movers or by the power company, a sensitive graphic meter should be used. Mr. Wattles pointed out that this peak load covers a very short time interval limited by the inertia of the engine flywheel, and may be a matter of a few seconds at most. In the case of purchased power momentary peak loads like those caused by the starting of industrial motors has little effect on the supplying system. For this reason a period of fifteen minutes or a half hour is used by many power companies for demand measurements. This demand for a particular month may be 25 to 35 per cent under the actual peak load, and should be so recognized in the comparison. Auxiliary power and light required in connection with Diesel plant operation should be included in energy computations. These points represent, of course, but one phase of the problem of industrial power supply, but they should be given due weight in such studies, for interest in the cost of meeting fluctuating demands from the capital investment standpoint was never greater among industrial plant engineers and owners than it is today.

X-Rays Reveal Successive Steps in Cable Oil Deterioration

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Cable wax, familiar and unwanted transformation of insulating oil under electrical stress, is an indirect result of several changes.

Crystalline wax, amorphous wax and cable wax the successive steps in paraffin breakdown.

Perhaps the crystalline wax can be controlled and more serious deterioration prevented.

FORMATION of cable wax within an operating cable has been recognized for many years, but no information has been obtained by the classical methods of research concerning the mechanism of the transformation of insulating oil into cable wax. X-ray diffraction methods have been found to be applicable to an observation of the intermediate steps in this transformation. The results of the work done in the X-ray laboratories of the University of Illinois may be summarized as follows:

1. Insulating oil under electrical stress is converted into a crystalline wax remarkably similar to paraffin wax; under further stressing this crystalline wax is converted into an amorphous wax which upon heating is reconverted into crystalline wax and which after prolonged stressing results in cable wax, the product familiar to cable engineers.

2. The percentage of crystalline wax found in stressed electric cables is a function of the magnitude of the electrical stress undergone by the cable, and the curve representing the crystalline wax content as a function of the radius of the cable is similar to that representing the variation of stress with radius.

3. The crystalline wax content of a stressed cable decreases with rest and with heating, although with but slight heating the concentration increases.

4. Since crystalline wax is formed before cable wax and since a relatively simple X-ray method, accurate to within 2 per cent, exists for estimating this crystalline wax content, it is possible that the future performance of cables may be predicted quite readily by determining the crystalline wax content after a relatively short known period of stressing. Moreover, the above X-ray method, since only a fraction of a drop of material is required for a sample, is capable of detecting relatively small changes in various regions of the insulation. With but few exceptions, all the test methods of the past measured the characteristics of the entire insulation in the sample of cable under test. The advantage to be gained by measuring, rapidly (one to two hours), simply and accurately, small changes in different portions of the insulation from conductor to sheath is obvious.

5. The phenomenon of cellulose sputtering from paper insulation in cables was observed during the investigation. The positive catalytic effect of this shattering upon polymerization and condensation processes from the standpoint of absorption is suggested immediately.

Pursuing the idea that cable wax was the end product of a series of transformations which included crystalline wax, a preliminary experiment was undertaken to determine what, if any, similarity existed between a pure cable insulating oil in which paraffin had been dissolved and an oil which had been subjected to electrical stress in service. The result of this experiment is shown in the group of X-ray diffraction patterns comprising Fig. 1. The first of these four patterns shows paraffin wax alone; next, cable oil alone, and, third, a mixture of paraffin wax and oil. The fourth pattern was obtained with a sample of impregnating compound removed from a deteriorated cable. The practical identity of the third and fourth patterns is evidence that the deteriorated oil is actually a mixture of crystalline wax and oil.

Wax proportional to stress

It was found early in the investigation that the amount of crystalline wax present in a cable impregnating compound was proportional to the stress applied to the cable while in service. Unstressed cables contained no crystalline wax. Cables which had been but slightly stressed showed small amounts of crystalline wax and completely deteriorated cables showed percentages of crystalline wax sometimes as high as 40 per cent. Since the magnitude of the electrical stress applied to the cable probably has a predominating influence upon the amount of crystalline wax formed, it follows that the curve representing the crystalline wax content as a function of the radius of the cable should be at least similar to that representing the stress as a function of the radius. In order to investigate this point a cable which was known to have been subjected to considerable stress was opened and as the paper tapes were unwound samples of impregnating compound were removed and analyzed. The accompanying graph (Fig. 2) shows the results of

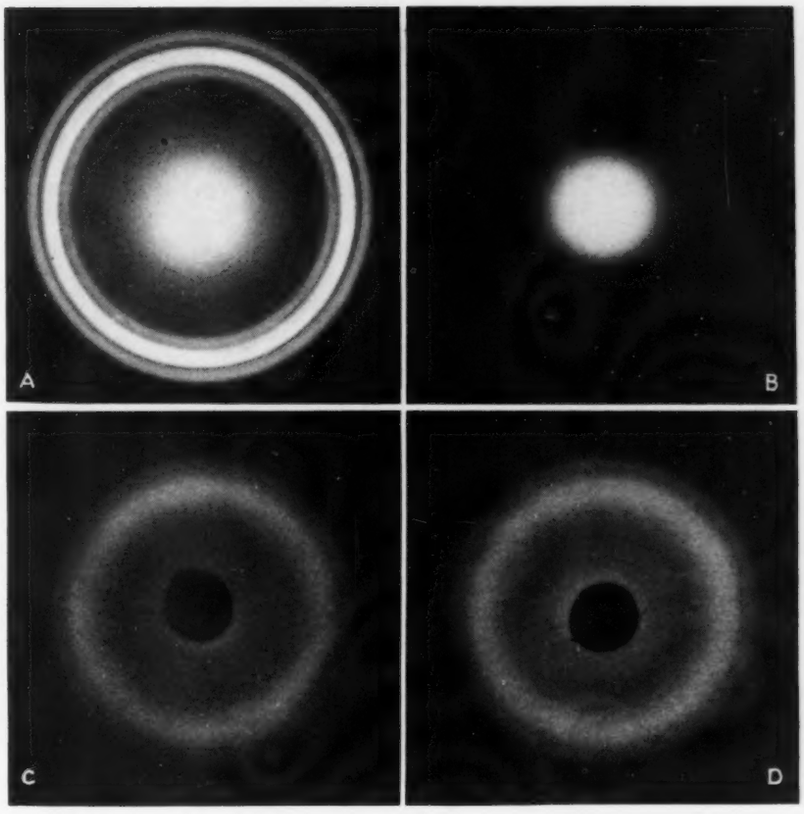


Fig. 1—Method of analysis for crystalline cable wax

The X-ray diffraction pattern of 100 per cent paraffin wax is shown at A. At B is the pattern of 100 per cent impregnating cable oil and at C of a mixture of 10 per cent paraffin wax and 90 per cent cable oil. The crystalline pattern of the wax is shown superimposed upon the amorphous pattern of the oil. Pattern D shows a sample of impregnating compound removed from a deteriorated cable. Since the relative intensities of the crystalline wax rings and the amorphous oil bands are very much the same in this pattern as in that of pattern C it may be assumed that there was approximately 10 per cent of wax in this particular sample of impregnating compound removed from the stressed cable. The black centers of the two lower patterns are images of lead beads to minimize the intensity of the central spot. By establishing a series of suitable standards it was found that the crystalline wax content of a cable oil could be estimated to within 2 per cent.

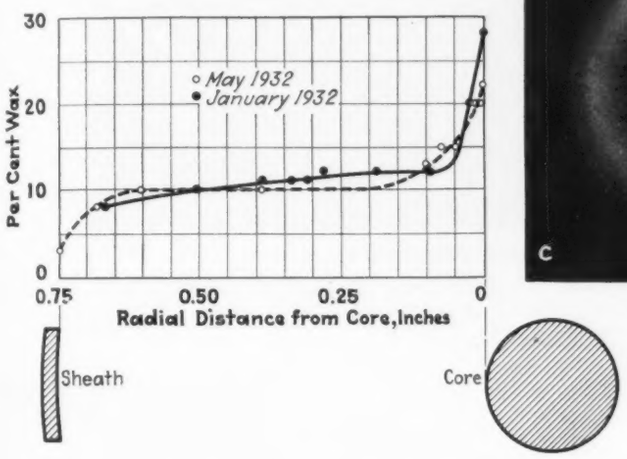


Fig. 2—Wax formation related to stress gradient

two investigations performed in this manner on the same piece of cable which was under no stress in the period between the two experiments. It should be pointed out that these two experiments are concerned with a crystalline wax similar to paraffin and not with the insoluble final wax with which cable engineers have become familiar.

By means of fractional solution in petroleum ether the crystalline wax formed in the insulating compound was removed and purified and direct X-ray comparison of this wax with paraffin established the identity of the two as is shown in the pair of diffraction patterns (Fig. 3). By employing a technique suggested by Trillat and modified by various subsequent workers it was found that the crystalline cable wax molecule had a length of 76.6×10^{-8} cm. as compared with a length of 38.4×10^{-8} cm. for the paraffin wax molecule. The one is nearly double the other, indicating that a linear polymerization has resulted.

During the course of the investigation of the crystalline wax content of stressed cable, occasion was had to study cables which had been overstressed to such an extent that the liquid compound of the original cable had been converted practically completely into a solid material. On X-ray analysis this solid material gave an intensity of crystalline wax corresponding, when compared with the standard, to a crystalline wax content of usually less than 5 per cent. However, on the patterns which yielded these anomalous results it was found that a second amorphous band was present within the amorphous band due to the oil. This second amorphous band

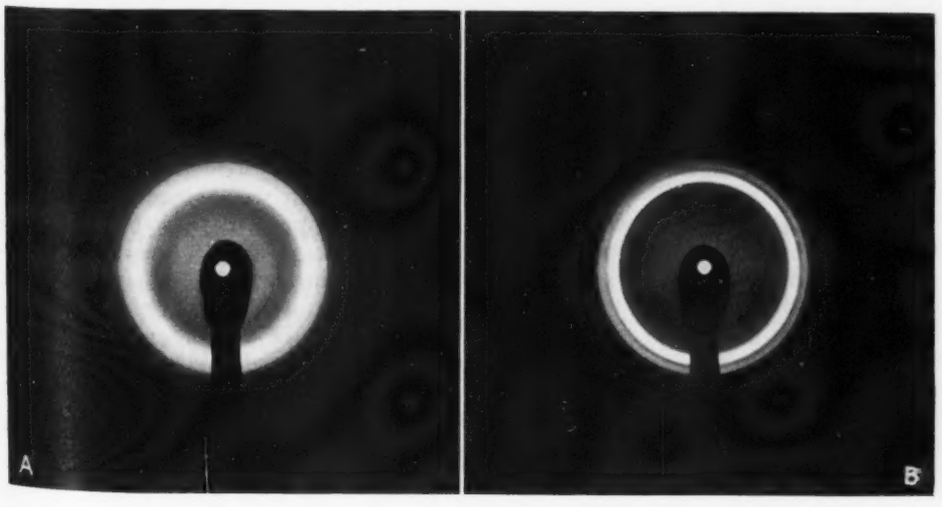


Fig. 3—Crystalline wax compared with paraffin

The relative difference in intensity is due to the fact that the two samples were not of the same thickness.

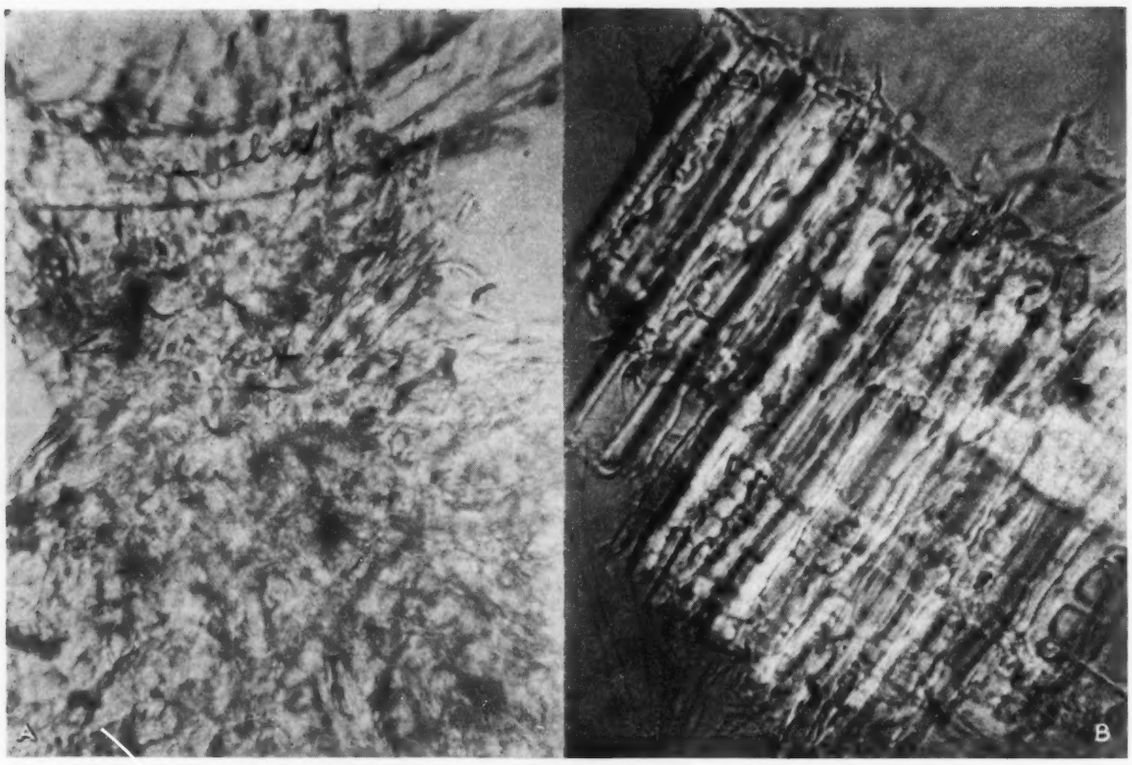


Fig. 4—Fibrous structure of amorphous insoluble residue

A shows a single fiber of cellulose in the presence of considerable material which shows no fibrous structure. B shows a large amount of cellulose fibers in the presence of only a slight amount of the high polymers. These pictures are proof of the fact that the insoluble residue is a mixture of finely divided cellulose and of a substance insoluble in ordinary solvents which is familiar to cable engineers as cable wax.

was not observed on any of the previous patterns, and its presence can be explained in only one manner. That is, under prolonged electrical stress crystalline wax is polymerized into larger three-dimensional polymers. Such a large polymer, provided it is not too large, may be unstable and susceptible to decomposition by heat, and when the solid material was heated and again analyzed the percentage of crystalline wax assumed a higher value. This leads to the conclusion that slight heating will increase the crystalline wax content of stressed impregnating compounds. Prolonged heating, however, decreases the crystalline wax content since a tendency for this wax to disappear on heating has been observed.

Cable wax includes cellulose

The insoluble residue found in cable insulating oil which is known to engineers as cable wax was found to be a mixture of finely divided fibers of cellulose and highly polymerized hydrocarbons. This is apparent from the two accompanying photomicrographs (Fig. 4) taken by Mrs. Wandan K. Farr of the Boyce-Thompson Institute. The outward appearance of the insoluble residue resembles that of paper pulp to an amazing degree. This substance was found to be completely insoluble in ordinary solvents. Treatment with hot concentrated sulphuric acid reuslted in some charring indicative of the presence of cellulose, although for the most part the substance remained inert to the action of this reagent. On heating in a crucible the substance first charred and then without melting burst into flames, burning with a yellow smoky flame and with the formation of considerable amounts of carbon. Only a small amount of ash remained. An X-ray diffraction pattern of the insoluble residue (Fig. 5) showed only an amorphous band. This residue, unlike the amorphous wax previously mentioned, exhibited no sign of crystalline wax after being heated.

Fig. 5—X-ray pattern of cable wax and fibrous material

Only an amorphous band is observed indicating the presence of only a small amount of highly ordered aggregate. The cellulose fibers have been completely shattered and the final cable wax is amorphous in nature.

This result, in connection with the fact that the residue is quite inert to the action of strong chemicals and all solvents, is indicative of its high molecular weight, since it is well known that the larger the molecules of a compound the more inert is the compound to any treatment that it may undergo. The final polymer, cable wax, is of an exceedingly high molecular weight and hence of exceedingly stable form, certainly more stable than that smaller amorphous polymer which decomposed on slight heating in ordinary crystalline wax.

That cable wax was very inert and was always present in deteriorated cables were the only known facts concerning cable wax until Hirshfield, Meyer and Connell in 1927 published their importnt investigation into the phenomena associated with wax formation.

When one considers the method of preparation of cables, the coiling and uncoiling upon drums for ship-

ment, the twistings and distortions consequent to installation, the considerable variation in temperature under operating conditions, and finally that voids are created in the cable during manufacture, it must be assumed that gaseous pockets exist within the cable. Since any void in the cable must be regarded as a dielectric in series with the composite dielectric it follows that under these conditions the distribution of potential is such as to place a comparatively high potential gradient through the void space with consequent electrical discharge. The electrical discharge is a flow of electrons and, since the sudden stoppage of these electrons should result in the generation of X-rays, it should be possible to detect this radiation emanating from an operating cable with removed sheath. Baker and James have verified this by actually observing X-rays being generated within the cable under stress. Thus there is no doubt that there are fast moving electrons present within the insulation of an operating cable.

The work of Lind and Schoepfle and Connell indicates that the effect of these fast-moving electrons upon hydrocarbons such as constitute ordinary insulating oil is best described as being a series of polymerizations and condensations. During condensation hydrogen gas, together with certain other gases, is liberated, creating more gaseous pockets within the insulation and enhancing further electron bombardment with subsequent increasing polymerization and condensation and liberation of additional gas. Our research was concerned with a study of the mechanism of these changes by utilizing X-ray diffraction methods and indicates that oil under stress is converted to a crystalline wax, then into an amorphous wax unstable to heat, and finally into familiar cable wax.

It might be pointed out that the changes taking place within an operating cable seem to us to be very similar to those taking place in the natural formation of crude petroleum from carbonaceous material.

The authors wish to express their appreciation to D. W. Roper of the Commonwealth Edison Company, Chicago, for his help and suggestions during the course of these investigations.

Avoiding Severe Stresses in Buses

In seeking to minimize the mechanical stressing of solid conductors whose usefulness is wholly electrical many methods have been devised.

Here are some of the danger points recognized by one engineer in seeking a planned approach to the problem.

VARIOUS methods have been employed to avoid excessive mechanical stresses when buses expand with temperature or when equipment attached thereto settles on its foundation or vibrates. Some of the factors which need consideration in handling these problems were discussed recently before a group of New England engineers by R. E. Anderson, Delta-Star Electric Company. In part, he said:

Strains due to temperature

Strains of any magnitude, due to temperature, can only occur on long, rigidly supported buses. In such cases the maximum sag or side play is not sufficient to take up the increased length, which therefore must appear at the end of the bus. If the bus is not too long it can be rigidly clamped in the middle and the other supports so made as to allow a movement through slippage to either end. It should be realized, however, that it takes a certain amount of force to move a busbar through a support even if not rigidly clamped. This force is proportional to the weight of the busbar. The coefficient of friction of one metal on another when dry averages about 0.2. Due to binding and misalignment it is logical to muliply this factor by 5 in order to be on the safe side in calculating frictional forces. This means that the force due to friction on each free support may at times equal the weight of the bus on each support. The force on the rigidly clamped support will be zero if it is in the exact middle of the bus.

However, it is not always possible to hold the bus in the middle. Sometimes one end must be fixed on account of connection to equipment where space is not available for an expansion joint. This means that all the motion due to expansion must be taken care of in one direction and the force, due to friction, on this fixed support may be equal to the total weight of the entire bus run. In such cases the force due to friction should be considered and if found excessive it will be necessary to break up the bus with expansion joints at positions where space is available. If possible the bus with the fixed end should be avoided by connecting to the equipment with an expansion joint. It will then be possible to fix the bus in the middle and let all the other supports run free. This construction has the added advantage of allowing for mechanical expansion or vibration where the connection is made to the equipment.

High-voltage steel structures flexible

In cases where the bus is mounted on a steel structure only the difference between the coefficient of expansion of copper (0.0000093 per deg. F.) and steel (0.0000067 per deg. F.) need be considered. This is equal to 0.0000026. For a 100-ft. run and 100 deg. F. rise this factor gives a difference in length of only 0.32 in. It can therefore readliy be seen that expansion due to temperature is not a serious trouble on a steel substation, especially on the higher voltages where the insulator stacks have a certain amount of flexibility. In such cases it is not even necessary to provide free running connections to the bus.

Strains due to mechanical movements

Strains of this nature can be divided into two classes: (1) Those due to an actual shift in position, such as

those caused by footing settlements, and (2) those due to vibration. The first of these is usually the most serious and is encountered wherever connections are made to oil circuit breakers, transformers or other equipment which have footings separate from the main structure. If the footings are of such a nature that very little shifting may be expected, these connections can usually be made quite satisfactorily with cable if one bend can be incorporated in the connection. For larger differences, it is best to resort to some type of expansion joint. For strains caused by vibration it is usually best to use an expansion joint flexible in all directions, such as one made entirely of braids.

Braid vs. laminations

Expansion joints in general are commonly made either of copper braid or thin copper laminations. The braid has the advantage of extreme flexibility and therefore does not often break off from repeated bending. It is, however, rather bulky and therefore restricted in its use to places where room is available for the necessary braid to carry the current. Since the braids are made of rather small wires (usually No. 32) it suffers considerably in some atmospheres from corrosion. This difficulty can be overcome quite easily, however, by using a braid woven from pretinned wire.

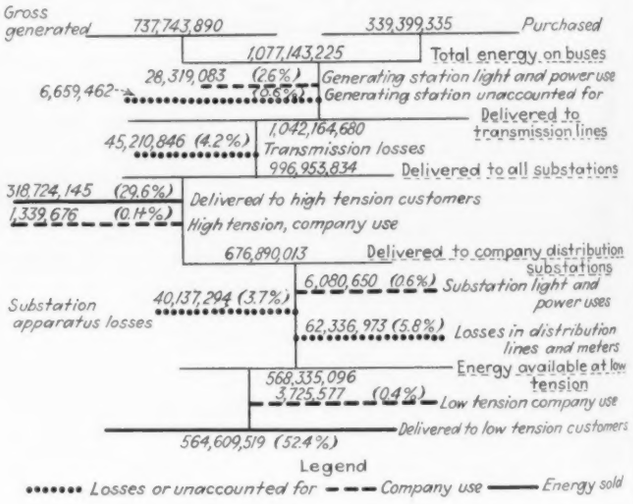
Laminations, on the other hand, lend themselves quite readily to heavy current expansion joints, as a considerable cross-section can be crowded into a small space. But they are not flexible in all directions and designers must carefully consider their action when subjected to repeated bends or laminations will crack off. Too thin liminations should be avoided as wind has been known to break off some of the thinnest sizes. That is, a lamination should not be made any thinner than the flexibility of the joint requires. Corrosion is usually not a serious trouble with laminations unless they are extremely thin.

Many users in the past have required and still continue to specify that the connections to a braid or laminations be made by sweating under pressure or by brazing. Either procedure appears detrimental to the life of the braid or laminations. Sweating is very apt to leave a little flux in the joint, which sooner or later causes corrosion. This is especially true in the case of braid, where a little corrosion plays havoc with the small wires. Both sweating and brazing require considerable heat, which anneals the braid or laminations near the joint. This annealing, coupled with the stiffness of the flexibles due to the solder, often causes the bend to repeat itself at this point and a broken braid or lamination is the ultimate result. The speaker recommended the use of a slug made from copper tubing for connecting braid. The tubing is flattened down over the braid under hydraulic pressure and pressed to give a good contact surface. The bolts holding the slug to the rest of the joint assembly should pass through the slug so there is no chance of the slug loosening up and releasing the braid. In the case of laminations a bolted contact is very satisfactory if the laminations are backed up with a solid piece or keeper.

There are some cases where it is desirable to tin the ends of flexible laminations together. This procedure keeps the whole lamination assembly in one piece until it reaches the job, and it is proper to use the solder if the movement to be taken care of is slow and of not too great a magnitude, for the reason already mentioned. In this case the soldered portions should be washed in some neutralizing solution such as denatured alcohol after tinning, to remove excess flux.

18 Kw.-Hr. Absorbed for Every 82 Sold

An over-all analysis of the disposition of energy during 1932 was recently filed by the Boston Edison Company, based on gross kilowatt-hours generated and purchased. The company produced 737,743,890 kw.-hr. in its own plants and purchased 339,399,335 kw.-hr. Of this total of 1,077,143,225 kw.-hr. delivered to the buses 318,724,145 kw.-hr. was delivered to high-tension customers (receiving energy at 6.9 kv. and upward) and 564,609,519 kw.-hr. was delivered to low-tension customers (4 kv. and below). The breakdown of energy analyzed is shown in the accompanying chart. The efficiency of delivery from generating and purchasing buses to all substations was 92.55 per cent, and the losses between company distribution substations and low-tension customers, including energy for company use, were over 16 per cent of the energy delivered to these substations, or over 10 per cent of energy generated and purchased.



Energy breakdown diagram, Boston Edison system, year 1932

High-tension customers' meters are in general read at the end of each month, so that the kilowatt-hours delivered during the calendar year are substantially the same as those "billed" or "sold." In the case of low-tension customers, meters are read continuously during the month, so that the energy delivered during the year differs slightly from that billed or sold. For comparison, low-tension sales in 1932 were 565,423,738 kw.-hr., or 0.14 per cent above the total low-tension delivery figure. Had the audit been figured on the basis of net output the proportion of energy delivered to all substations would have been 95 per cent instead of 92.55 per cent and the efficiencies further on would have been somewhat higher.

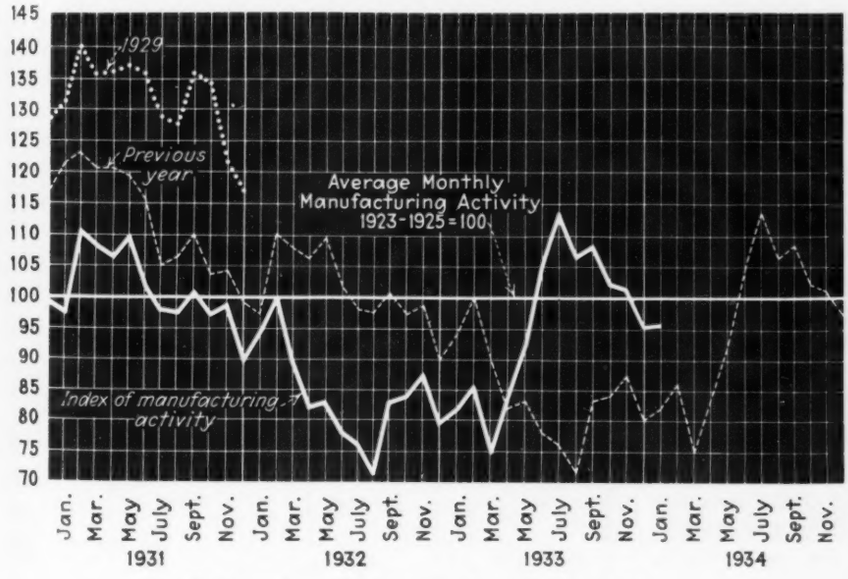
Manufacturing Holds December Level

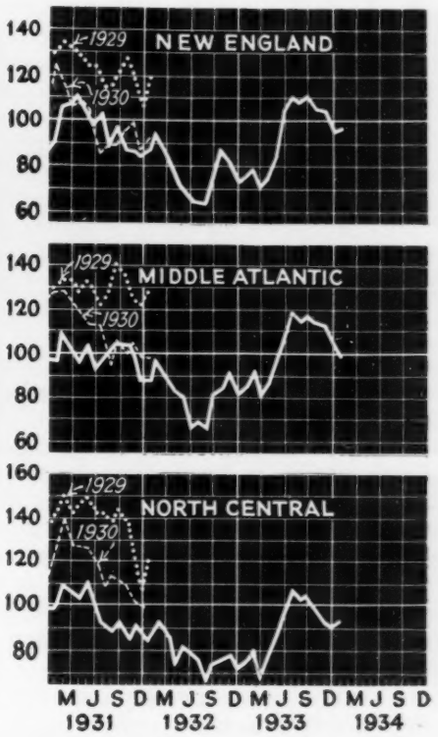
INDUSTRIAL activity during January in the United States as a whole maintained the same average rate as in December, about 6 per cent under November but 17 per cent above January of last year, gaged by electrical energy consumption in representative manufacturing establishments as reported to ELECTRICAL WORLD in its monthly survey. Revisions of the index numbers to include delayed returns raised the November average slightly over the figure previously announced and lowered December, changing the gain for the latter month to 20 per cent compared with December, 1932.

As the charts show, the expansion of operations culminated in July, after having continued nearly a year, though with much irregularity during the first two-thirds of that period. The subsequent recession has been moderate but definite. It has brought the average 15 per cent below the peak attained a year and a half ago.

Movements of individual industry groups from the December level were in general slight. For automobile plants data thus far received indicate a rise of 14 per cent, which accords with news reports of increased employment. The allied rubber industry advanced 16 per cent.

The changes are more clearly evident in the regional figures. In New England the metal-working plants continue at a much higher rate than a year ago, the increase exceeding 50 per cent. In the iron and steel industry a rise of 70 per cent remains despite some recession from autumn activity. Textiles, rubber and leather recovered recent moderate recessions more or less completely and, with the exception of the one last named, are well above the level a year ago. In textiles the year's net gain was 22 per cent. Forest products alone remain abnormally low. The effect of all these various movements has been to bring the regional average 28 per cent higher than in January of 1933.





Index of monthly manufacturing activity

Base: Average month 1923-1925 = 100

(Corrected for number of working days, but not for seasonal variation)

These data are compiled by ELECTRICAL WORLD and are based on monthly consumption of electrical energy by 3,800 large manufacturing plants in various industries and scattered throughout the country.

Industrial Groups	United States				New England				Middle Atlantic				North Central			
	Jan., 1934	Dec., 1933	Nov., 1933	Jan., 1933	Jan., 1934	Dec., 1933	Nov., 1933	Jan., 1933	Jan., 1934	Dec., 1933	Nov., 1933	Jan., 1933	Jan., 1934	Dec., 1933	Nov., 1933	Jan., 1933
All Industry	**960**	**95.5***	**101.8***	**81.9**	**96.8**	**95.3***	**104.0**	**75.5**	**99.3**	**104.3***	**112.0**	**85.7**	**92.8**	**90.3***	**94.1***	**76.3**
Automobile (including parts and accessories)	63.3	55.5	49.3*	59.2	....	....	....	....	64.6	66.8*	61.9	65.5	62.1	55.7	48.1*	58.7
Chemical products (including oil refining)	150.5	162.1	161.3	126.0	148.7	166.9	164.8	147.0	164.5	168.0*	174.8	133.6	127.5	130.5*	140.7	116.0
Food products	106.0	107.3	125.0*	107.5	....	....	....	....	106.3	111.0*	127.3	106.0	100.2	102.4*	123.0*	104.7
Iron and steel	75.0	75.7*	71.0	58.4	117.0	129.6	130.2	68.8	68.3	69.0*	66.6	47.0	75.7	76.2*	70.1	65.5
Metal working	77.8	77.5*	78.0*	52.8	107.2	105.8*	113.3*	70.0	64.3	66.2*	69.2	50.3	85.2	82.2*	79.7*	51.2
Metals group	76.8	77.0*	75.6*	54.7	110.0	112.7*	118.2*	69.7	66.0	67.4*	68.2	48.9	81.7	80.0*	76.0*	56.5
Leather products	88.7	85.5	89.3	83.6	70.5	62.8*	69.7	76.4	107.5	104.9	108.6	95.8	86.3	86.8	87.7	77.1
Forest products	96.0	97.8*	104.6	90.4	44.7	49.3*	56.5	38.9	60.8	63.7*	77.0	54.2	87.5	84.0*	91.9	67.7
Paper and pulp	118.3	120.0*	127.4*	104.4	128.0	127.0*	132.8*	99.2	93.2	98.0*	105.0	83.2	110.5	107.3*	114.8*	103.0
Rubber products	126.5	108.2	115.6	85.2	107.5	100.6	122.4*	89.7	....	....	....	....	131.6	108.5	112.8	81.5
Shipbuilding	91.0	89.3*	86.7	83.5	....	....	....	....	....	....	....	....	....	....	....	....
Stone, clay and glass	74.3	72.2*	91.5	58.5	....	....	....	....	41.8	46.2*	74.4	43.3	105.0	91.0*	105.2	73.7
Textiles	99.5	94.6*	108.5	85.0	77.8	69.3*	81.8	63.7	128.0	131.7*	149.1	111.8	145.0	147.0*	171.2*	109.2

*Revision.

What Do the Refrigerator and Range Mean to Utilities?

Seeking to study the effect upon the use and revenue of individual customers four companies undertook a careful analysis.

Increase in revenue from added ranges 13.4 per cent; from refrigerators 63 per cent.

Consumer benefits reflected in rate reductions on basis of 52.6 per cent and 37 per cent.

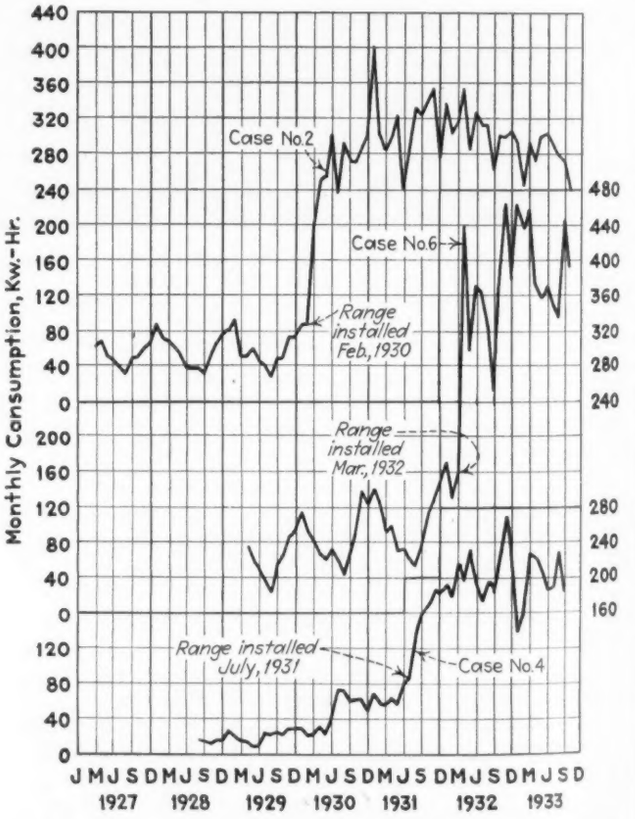
NO ONE questions that ranges and refrigerators increase business, but when one turns to specific installations it is useful to observe how much more service results, what it means over a given period and what the effect is upon the average rate paid for electricity for a given increment investment, if any. If a group of well-established customers who happen to have added no other equipment of importance during the period is studied, the effect of putting a range or refrigerator at work in the home can be reasonably well approximated, provided the living habits of the household have remained about the same. Such information represents in a way the proof of the pudding of commercial effort, and because of its specific nature should stimulate vigorous sales activity based on executive support wherever such enterprise has been lacking.

An analysis of this kind was recently made by an Eastern utility in determining the going value of a power company in a rate case. The value of attached business was a feature emphasized as an element of going value. It was brought out that an estimate of the cost of reproduction of the physical plant and facilities of the property during a reasonably assumed period of construction provides only for the cost of the plant and cannot reasonably be assumed to include the cost of securing and attaching the business of existing customers, which could only be obtained in the case of a newly reproduced plant by additional expense and effort over a substantial period of time following the initiation of operations. The construction of a plant lends itself to planning and scheduling for completion within a definite and relatively short period. The time required to obtain attached business and the work and activities associated with its procurement involve considerable costs, and to indicate the value of such commercial development work the study was initiated to contrast the revenue-producing capacities of the installations, before and after the appliances mentioned were placed in service. Thus, while the study was designed to show the influence of load-building activities upon going value, it revealed the commercial results of aggressive salesmanship.

The source data in the study came from four power companies under the same general executive management. In each of the eight cases where electric range effects on the consumption of energy were studied and

Table I—Results of Adding Ranges and Refrigerators

	Average Annual per Customer Revenue	Kw.-Hr. Sales		Average Rate Cents per Kw.-Hr
Electric Ranges				
Eight Customers				
Year after installing range.....	$157.58	2,944		5.36
Year before installing range.....	67.53	831		8.13
Gain in company business.....	$90.05	2,163	Customer saving	2.87
Electric Refrigerators				
Six Customers				
Year after installing refrigerator.	$65.70	1,187		5.54
Year before installing refrigerator	40.26	531		7.58
Gain in company business.....	$25.44	656	Customer saving	2.04


Monthly Consumption, Kw.-Hr.
Case No.2
Case No.6
Range installed Feb., 1930
Range installed Mar., 1932
Range installed July, 1931
Case No.4
J M J S D M J S D M J S D M J S D M J S D M J S D M J S D
1927 1928 1929 1930 1931 1932 1933

Figs. 1, 2 and 3—Stimulation of usage by ranges in typical homes with three, five and one persons in family

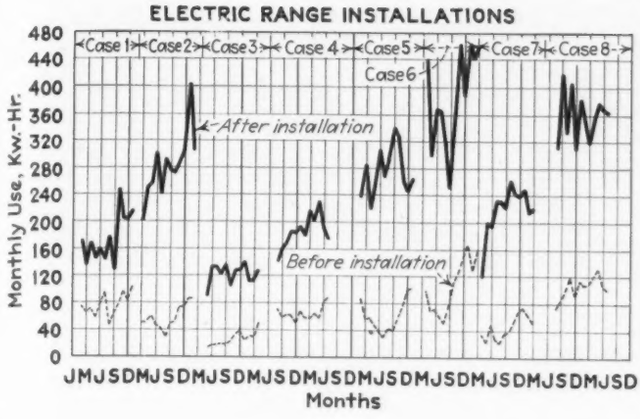
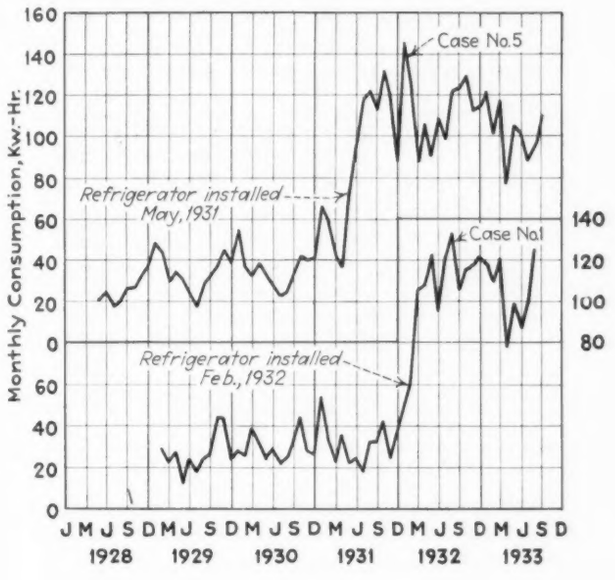


Fig. 4—Comparison of domestic usages for year before and year after adding an electric range in eight installations

Figs. 5 and 6—Increase in consumption due to refrigerators with two and four persons in the family



in the six cases of electric refrigeration analyzed, the local sales organization was familiar with the conditions in the family, the number of persons, size of range, make of refrigerator and comparatively unchanged general conditions of other household service along electrical lines prevailing through the periods covered. In all but one case (eleven months) a full year's operations were contrasted before and after adding a range or a refrigerator.

The customers adding ranges raised their purchases of energy an average of $90.05 per year and those adding refrigerators increased their bills on the average by $25.44 per year. The average rate paid per kilowatt-hour dropped by 2.87 cents in the case of the range customers and by 2.04 cents in the refrigerator installations.

All four companies had promotional room rates in force during the periods to which the analysis applied. The prices in the rates were:

		Cents per Kw.-Hr. Net
Company H: Rate "A"	First 4 kw.-hr. per room per month at	9½
	Next 4 kw.-hr. per room per month at	7
	Next 200 kw.-hr. per month at	4
	Excess kw.-hr. per month at	2
Company N: Rate "9"	First 8 kw.-hr. per room per month at	9
	Over 8 kw.-hr. per room per month at	4
	Plus 20 cents net per room per month, minimum six rooms.	
Company M: Rate "A-1"	First 4 kw.-hr. per room per month at	7½
	Next 4 kw.-hr. per room per month at	5½
	Over 8 kw.-hr. per room per month at	3½
Company R: Rate "A-1"	First 4 kw.-hr. per room per month at	8½
	Next 4 kw.-hr. per room per month at	5½
	Over 8 kw.-hr. per room per month at	3½

Another rate used by Company R (its schedule A) billed the customer 75 cents for the first 3 kw.-hr. delivered per month, plus 6.5 cents per kilowatt-hour for the next 17 kw.-hr., plus 5.5 cents per kilowatt-hour for the next 30 kw.-hr., plus 3.5 cents per kilowatt-hour for all over 30 kw.-hr. All four companies maintained minimum charges.

The month-by-month energy consumption of three typical range users is shown in Figs. 1 to 3 inclusive, the number of persons in the family being three, one and five. The plots show marked seasonal variation in usage in two cases and in two cases a gradual upward trend in the consumption of energy before the range was added. These plots cover from four to six years' service. The effect of the range in each case is striking, and in Fig. 4 a concentrated plot of the year before and the year after adding the ranges is reproduced for all eight cases. The details of energy consumption, bills, average rates and increment investment appear in Table II. Not only was there a marked reduction in the average rate per kilowatt-hour consumed in each home as the ranges were added, but the average rate on the increased energy taken was lower than the average for the total consumed, which accords with promotional rate design in general principles.

The effect of adding a refrigerator to a domestic consumer's load is

Table II—Effect of Electric Range With Promotional Rates

	Case Number								
	1	2	3	4	5	6	7	8	Summary
Consumption:									
Year after....	1,978	3,373	1,500	2,213	3,308	4,628	2,638	4,312	23,950
Year before...	883	690	455	769	733	1,276	562	1,280	6,648
Increase....	1,095	2,683	1,045	1,444	2,575	3,352	2.076	3,032	17,302
Revenue:									
Year after....	$96.40	$185.32	$93.48	$101.48	$197.12	$231.10	$140.08	$215.68	$1,260.66
Year before...	52.60	77.86	40.16	43.72	86.55	95.35	49.60	94.40	540.24
Increase....	$43.80	$107.46	$53.32	$57.76	$110.57	$135.75	$90.48	$121.28	$720.42
Average Rate:									
Year after, cents.....	4.87	5.50	6.23	4.59	5.95	5.00	5.31	4.99	5.26
Year before...	5.96	11.28	8.85	5 69	11.80	7.48	8.83	7.36	8.13
Ave rate for increased use, cents.....	4.00	4.00	5.10	4.00	4.30	4.10	4.35	4.00	4.16
Number in family	4	3	2	1	5	5	3	3	26
Increment company, investment.....	$52.61	$12.00*	$33.35	$123.19	$69.53*	$50.00	$80.82	$123.36*	$544.86
Appliance:									
Size-Kw.....	8.0	7.5	8.16	8.0	7.5	10.5	10.5	7.5	.....
Rate Schedule:									
After†.....	A-(H)	9(N)	A(H)	A(H)	9(N)	A(H)	A(H)	9(N)	.....
Before.....	A	9	A	A	9	A	A	9	.....

*Estimate. †Letter in parentheses indicates company.

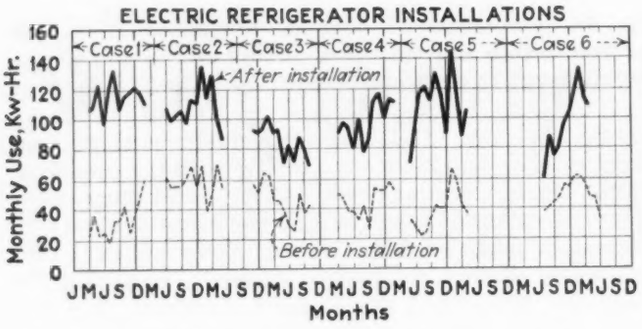


Fig. 7—Comparison of year before and year after refrigerators were added in six installations

shown in Figs. 5 and 6, over a period of four to five years, the number of persons in the family being respectively two and four. In each of these cases the winter peaks were marked before the refrigerator went into service, but the increase in usage was very striking afterward. While there were marked fluctuations in month-by-month usage after the refrigerator was installed, the summer consumption tended to minimize the contrast between the former winter peak and the usage in the balance of the year. The effect of the refrigerator on the use of energy was immediate.

A summary graph of the six installations studied is shown in Fig. 7, covering the energy consumptions month by month for the year before and the year after installation of the refrigerators.

A tabulated summary of all the refrigerator service, which incidentally involved no increment cost at these residences in the way of investment in wiring, etc., is given in Table III. The customers and the company were both gainers by the additions. The former obtained increased revenue and the latter a lower average rate per kilowatt-hour. The value of the business is very marked.

Table III—Effect of Electric Refrigerator With Promotional Rates

	Case Number						
	1	2	3	4	5	6	Summary
Consumption:							
Year after	1,330	1,302	1,016	1,182	1,318	972*	7,120
Year before	370	690	540	540	464	584	3,188
Increase	960	612	476	642	854	388	3,932
Revenue:							
Year after	$72.62	$73.51	$61.92	$62.93	$68.32	$54.92*	$394.22
Year before	30.65	51.00	41.61	40.37	35.86	42.11	241.60
Increase	$41.97	$22.51	$20.31	$22.56	$32.46	$12.81	$152.62
Average Rate:							
Year after, cents	5.46	5.65	6.10	5.31	5.19	5.65	5.54
Year before, cents	8.30	7.40	7.71	7.47	7.74	7.22	7.58
Ave. rate for increased use, cents	4.37	3.58	4.26	3.51	3.80	3.30	3.88
Number in family	4	3	4	4	2	4	21
Increment company investment	None	None	None	None	None	None	None
Appliance:							
Size cu. ft	6	6.2	.....	6.2	4.5	6.7	.....
Rate Schedule:							
After†	A-1(M)	A(R)	A(R)	A-1(M)	A-1(R)	A(R)	.....
Before	A-1	A(R)	A	A-1	A-1	A	.....

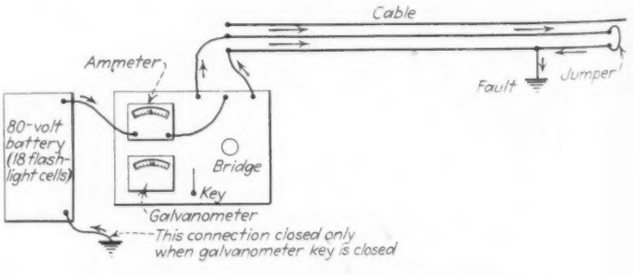
*Eleven months. †Letter in parentheses indicates company.

Flashlight Cells Adapted to Loop Cable Tests

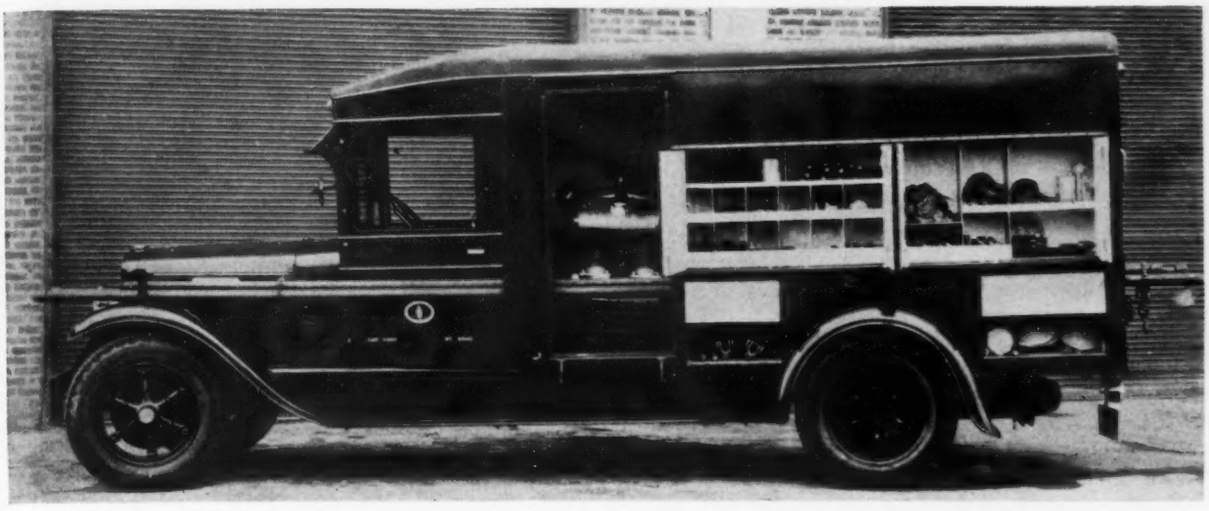
By reducing the flow of energy during tests to the moment when the galvanometer key is closed standard Murray loop tests to locate cable faults may be made with dry cells

With a source of sufficient direct current available the standard Murray loop test is a time-tried and effective method for locating certain types of cable faults. When a line source of direct current is not at hand batteries are frequently used. But batteries capable of a continuous drain of 4 or 5 amp. at 80 to 100 volts are a pretty heavy load to carry around. The cable testers in Milwaukee lighten that load considerably by using flashlight batteries instead of standard size dry cells. But you can't pull 4 or 5 amp. continuously from a flock of flashlight batteries. That's very true, and therefore the testing set is operated somewhat differently from the ordinary way.

The usual method of operating the set is to manipulate the bridge resistance control, periodically closing the galvanometer key until the instrument is in balance while a continuous current flows in the cable to and from the fault. But the current does not necessarily have to flow while the resistance control is being manipulated. It must flow only when the galvanometer key is closed. Therein lies the trick of using flashlight batteries. Eighteen 4½-volt batteries connected in series are carried in a wood box. One lead from the box is connected to the test set. The other (ground) lead is left unconnected. Then, after a tentative bridge setting has been made, the free battery lead is touched to the ground connection at the same instant that the galvanometer key is depressed. Thus the batteries are subjected only to intermittent drains instead of to a continuous one and their life is protected.



Saving battery current in cable test



Combination utility truck with compressor integrally mounted and driven by truck engine

Combination Trucks Speed Maintenance

For those relatively small jobs requiring heavy-duty, compressed-air-operated tools regular compressor-trailer units are costly. On one-hour-or-less jobs this utility finds a truck-mounted unit to offer savings.

MARKED economies in maintenance and construction work have been achieved by the Boston Consolidated Gas Company on its distribution system through the development during the past three years of so-called combination compressor trucks which do away with the disadvantages of equipment in which such apparatus is hauled on separate trucks or wheels, is limited as to performance by cold weather conditions and at times inadequately co-ordinated with the labor forces in the field. At a meeting of the New England Gas Association in Worcester, Mass. E. H. Eacker of the Consolidated company described the development of this type of equipment on the Boston system and emphasized its value in street work.

Essentially the equipment consists of an ordinary motor truck with an air compressor mounted on it and driven by the truck engine. The basic idea, Mr. Eacker stated, is not new, but the Boston company's adaptation of it to utility service is of interest to power companies as well as gas utilities. The first unit was placed in service about sixteen months ago. It utilized a White truck chassis and the compressor was a 6x6-in., two-stage, single-cylinder machine, which had a displacement of 142 cu.ft. of free air per minute when running at 725 r.p.m. The compressor was mounted on the left-hand side of the unit just back of the cab. with the compressor tank on the right side in a similar location. This permitted operating the compressor at comparatively low speed, but increased the normal air supply sufficiently to enable two pavement breakers to be satisfactorily run at a time. The body was built up from an old platform body on hand. Tools, stock, compressor guns, compressor steel, gas masks and lanterns were carried in boxes along each side of the truck. The body layout left the middle portion of the truck available for carrying cast-iron pipe, hose, dirt, patch material, etc.

Nine objectives obtained by the design

In developing this truck the company endeavored to realize the following objectives determined from its studies of service needs: (1) Capacity of truck chassis, about 1.5 tons; (2) compressor and power take-off to be of light weight; (3) compressor to be air-cooled to reduce weight and eliminate use of anti-freezing solution in winter; (4) compressor and power take-off to occupy small platform space; (5) endless V-belt drive for economy and reliability; (6) compressor to serve two paving breakers; (7) power take-off applicable to practically all makes of trucks; (8) first cost lower than standard skid-mounted compressor; (9) simple control.

The truck shown in the accompanying illustration has been used daytimes to move and supply small working gangs with stock, besides giving compressor service. If the job time limit exceeds one hour the operator or gang foreman asks the truck dispatcher for a regular compressor unit. This concentrates the work of the combination unit on as many small jobs as possible. For night work the unit carries the necessary equipment and tools for all emergencies. Its use eliminated one platform truck and one compressor truck. The power dome was of the gear type, and of White make, though somewhat noisy when the engine is idling. The only maintenance required on the compressor in eleven months was replacement of one of its five belts. Operating experience showed that the most desirable type of power take-off would be a split propeller shaft, on account of its simplicity and adaptability to all makes of trucks. The Davey Compressor Company, Inc., Kent, Ohio, engineered such a take-off to permit the use of endless

belts, and the arrangement of the compressor and air tank was bettered by mounting both on a movable subbase resting on two channel cross members and mounting back of the cab center instead of outboard, as in the original layout.

Second unit of similar capacity

Last spring another combination unit was ordered for the high-pressure district. This had a special all-steel body with compartments on either side, open space through the middle, hose box behind the cab and a Waldon canvas top. The chassis was an International model "A-3," 1.5 tons, with a 160-in. wheelbase. The outfit has ample carrying capacity for welding equipment, pipe, road-patching material, and labor, in addition to the compressor, normal stock and tools. The compressor and air tank occupy a space only 36x41x39 in.; the compressor capacity is 142 cu.ft. per minute at 725 r.p.m.; the power required is 27 hp.; the motor speed is 1,648 r.p.m. and the weight of the compressor, power take-off, air tank, cross channel, sliding base, etc., is 968 lb. The total weight of the second combination unit is 7,500 lb. and its pay load is 4,800 lb. Its total cost complete was $2,916.

Air delivery tests on both combination trucks and the company's standard compressors showed that the air-cooled compressor compared favorably with water-cooled equipment. The gasoline consumption per cubic foot of air delivered was lowest with the second combination unit, probably because of the efficient truck motor speed. A five-hour endurance test on the second unit was satisfactory. The results have led the company to proceed with a third unit, which replaces the first in the downtown area, and with fully inclosed body, on account of its operation in 24-hour service. Mr. Eacker stated that the direct labor saving per year on units operating two shifts per day more than justifies the replacement of the conventional type of compressor with the combination compressor-truck outfit. Besides the gain from simultaneous arrival of men and compressor on the job, no time is lost by warming up the compressor driving engine, since the truck engine is already hot. Any type of body or truck can be used. No abnormal wear was found in the truck motor from compressor driving, a speedometer record indicating that 24,000 equivalent miles of engine operation were obtained in thirteen months in addition to about 8,000 road-miles. The use of the belt drive undoubtedly contributes to this result.

10,000-Lumen Sodium Units Light Revere

No longer but a convenient bogey man with which to frighten the old order, sodium-vapor lamps are finding a scattered popularity for their effectiveness as seeing aids and in reduced costs for highway illumination. Street lighting may stand on the threshold of a new era.

SODIUM-VAPOR street lights of 10,000-lumen series alternating-current design are being used at Revere, Mass. with notable success. Under the auspices of the Metropolitan District Commission units and luminaires designed and manufactured by the General Electric Company, have been installed there, C. A. B. Halvorson consulting engineer for the company, states, to illustrate pioneer features in reflector design and electrical control which differentiate them from the installation under and approaching the Scheldt River in Belgium (ELECTRICAL WORLD, January 13, 1934, page 93).

The Revere installation marks the use of the largest lamps ever put in service outside the laboratory and the largest fixtures so far employed. The sodium lamps used in the installations at Port Jervis and Schenectady, N. Y., were rated at 4,000 lumens. Fourteen years of research have brought the unit from a laboratory curiosity to a lamp sufficiently acceptable to the Massachusetts board to warrant that body's approval of a permanent installation on one of the most important highways leading to the Boston North Shore. Eleven units have been installed on a traffic "cloverleaf" or overpass by which the Revere Beach Parkway and Broadway, Revere, are separated at grade. The lamps are spaced up to a maximum of 300 ft. apart on one side of the highway and are mounted 19 ft. 6 in. above the 40-ft. wide roadway surface. The road surface is a bituminous macadam, which has the low reflection coefficient of about 4 per cent, but despite this it was easy to drive without headlights between lamps and newspaper print could be readily perused 50 ft. away from a lamp at the height of the eye. Computing from the substation of the Suburban Gas & Electric Company, which furnished the energy for the installation, the average over-all wattage per lamp, including circuit, constant-current transformer and interior losses, was about 350 watts. Visual acuity is about three times that obtained in ordinary street lighting at low intensities. Larger sized units were used to conform to American practice, which leans away from multiplying numerous small units in work of this kind. The input at the lamp proper is about 250 watts, giving an efficiency of 40 lumens per watt, compared with 10.7 lumens for the 40-watt incandescent and 19.4 lumens per watt for the 10,000-lumen series incandescent street lamp and 500-watt incandescent.

The lamps installed at Revere are tubular in shape, 3 in. in diameter and 16 in. long, the light source itself being 12 in. long. The reflector resembles the pontoon of a hydroplane, with two additional fins, and the fixture directs the light up and down the roadway with decided asymmetry. To accomplish this two 11-in. sections of parabolic cylinders opposite each other redirect the light. With a normal rating of 1,000 cp. per lamp, the reflector equipment sends about 2,500 cp. in useful directions. The

Night view of sodium lighting on Revere, Mass., overpass

Fixture mounting for sodium units at Revere

equivalent source area is about 108 sq. in., as contrasted with the usual assumed point source. On the street side of the luminaire is a semi-circular inverted parabola 25 in. in diameter which throws the light across the thoroughfare. Since the two parabolic cylinders have a combined length of only 25 in., there would be much wasted light above the horizontal if it were not for the two parabolic fins, which provide an effective width of 5 ft. in redirecting the light up and down the street. The reflecting surfaces are of aluminum processed to the hardness of chromium and used for the first time in this installation. This treatment makes the aluminum impervious to oxidation and also permits it to be cleaned with a non-abrasive agent.

To supply the heating filaments of the lamp with the proper current to ionize the neon gas with which the sodium cylinder is provided, and so to establish the discharge through the sodium tube, a special type of series transformer is mounted in the base of each pole. A timing device in the luminaire allows a one-minute interval for preheating the filaments. The luminaire is equipped with a series cutout to protect the service in case the lamp fails. The eleven units at Revere are on a 6.6-amp. series circuit with a number of 6,000-lumen incandescents. The heating filaments operate at 10 amp. and the sodium arc at 6.6 amp.

A similar installation of sodium lamps will be placed in service on the new Boston-Worcester motor highway in the city of Newton and another in Wallingford, Conn.

Insulation Testing Sets Checked by Voltmeter

Resourceful handling of single instrument permits close approximate check, without high resistance standards of readings of portable insulation test set

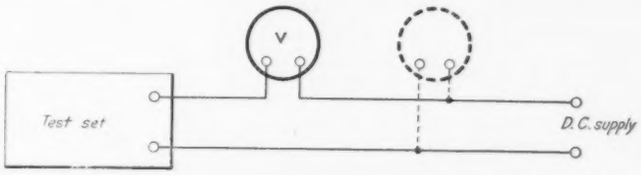
By G. W. STUBBINGS
London, England

Full calibration of an insulation test set requires either another set which has been standardized independently or a number of very high resistance standards, and it is only rarely that these means are available.

A very close approximate check can, however, be made if there is available a source of direct current of about the same voltage as that which is given by the generator of the test set. The terminals of the test set are joined to the source of direct current through a voltmeter whose resistance is known and whose range corresponds to the value of the pressure of the d.c. supply. The connections are so made that the voltmeter reads backward, and, with the generator of the set stationary, the pointer will deflect beyond the infinity mark.

Let the handle of the generator be turned in such a direction that its voltage opposes that of the source of supply. As the generator pressure is increased the current through the voltmeter will diminish, and when the generator pressure is exactly equal to that of the supply the voltmeter will read zero, and since the current in the circuit external to the test set is zero the pointer of the set will stand at the infinity mark.

If the generator pressure is still further increased the current in the external circuit will reverse its direction, the voltmeter will read in a forward direction and the pointer of the test set will move from infinity toward zero. The reading of the



Voltmeter used as resistor and indicator to check insulation-resistance test sets

voltmeter will now give the difference between the supply pressure and that of the generator, and if the former pressure is V and the voltmeter reading is v the generator pressure will be $V + v$. The current in the circuit external to the test set is evidently v/R where R is the resistance of the voltmeter. The test set is thus delivering to the external circuit a current whose value is v/R while the generator pressure is $V + v$. This corresponds to a direct connection of the set to a resistance whose value is $R\frac{V+v}{v}$ and, if correct, the pointer of the set will indicate this value.

To take a numerical example we may consider that the pressure of the source of direct current is 500 volts, the reading of the voltmeter is 25, its range is 0 to 750, and its sensitivity 100 ohms per volt. The generator voltage in this condition is 525 and the current in the volt external circuit is $\frac{25}{75{,}000}$ The apparent resistance of the circuit external to the test set is thus $\frac{75{,}000 \times 525}{10^6 \quad 25} = 1.575$ megohms. Other values of the apparent insulation resistance can readily be obtained by varying the speed of the generator so as to obtain a different reading on the voltmeter, and the highest point on the scale of the test set which can be checked is fixed by the lowest point on the scale of the voltmeter at which a reliable reading can be obtained.

Constant pressure test sets can be checked by varying the pressure of the supply by connecting the instrument to a potentiometer rheostat. It is evident that the best results are obtained by this method of checking when the voltmeter resistance is as high as practicable. It will therefore be convenient to increase the value of the quantity R by connecting in series with the voltmeter any standard high resistances which are available. If the pressure of the source of direct current is unsteady, the value of this pressure can be continuously indicated by a second voltmeter connected as shown in the diagram, and the values of the test set reading and of V and v can be simultaneously observed.

Leftovers Cease as Stockroom Problem

By PAUL S. HAMILTON

Assistant General Storekeeper Detroit Edison Company

As the result of an organized program, involving the appointment of a board of sixteen to review the status of 14,000 items stocked in its storeroom, Detroit Edison has reduced yearly write-offs of surplus and obsolete material to less than 0.50 per cent of an average $3,500,000 investment.

IN ALL kinds of business the efficient disposal of surplus and obsolete stocks of materials presents a continuous challenge to man's ingenuity. No company can dodge the issue, for "mañana" will come—the day of reckoning when all available warehouse space will be filled and the material and supplies account will be meaningless to the management.

After several attempts to solve the problem had failed the Detroit Edison Company came to the conclusion that the problem was company-wide. With this in mind the next step was the appointment by the management of a committee on the disposal of obsolete equipment and material and supplies. Named by the general manager, its personnel was picked from nearly every large department in the company and comprised sixteen members, including the chairman. These men were mainly engineers and were informed in their letter of appointment that "the purpose of this committee is to facilitate the systematic elimination of obsolete items of equipment and material and supplies from the company accounts." At the start this committee had a wealth of material to work with. It met frequently, but with the passing of a few years the system became so clean and the entire company so well educated to using up leftovers that the meetings became less and less frequent. Today this committee meets two or three times a year and finds that enough.

The mode of operation was to review every single item of the 14,000 regularly carried in stock. This was done at the large primary or ordering warehouses. Items that showed little or no movement were reported to the committee by the storekeepers. A brief history was prepared and typed on each list and a copy of all lists sent to every member of the committee. He was advised of the date of the meeting and asked to come prepared to discuss and advise on anything that concerned his department. The company, of course, much preferred a disposal of items by their use in its service, but, failing that, permission was asked by the stores department to sell or scrap. Some rather amusing and hot discussions occurred in the meetings, but nearly all soon saw the fundamental reasons back of the idea and to their everlasting credit aided and abetted the chairman in many ways.

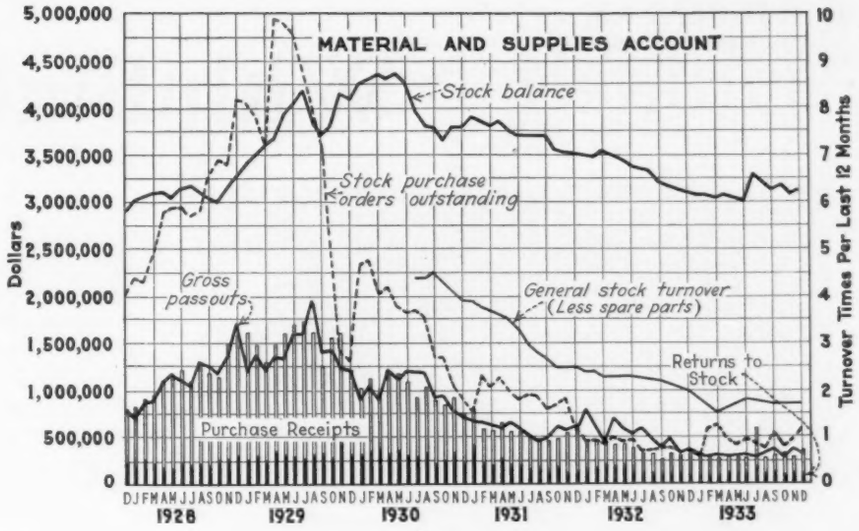
Dragging them into the light

As each item came up for discussion, its previous history was briefly stated. The history file (see "Control Methods Applied to Utility Stock," ELECTRICAL WORLD, page 83, January 13, 1934) here became most valuable. The non-stores department members saw what happened when poor estimating or careless ordering of materials took place. Gradually the useless and wild stock requests were curbed, open space began to appear on warehouse floors, and an orderly and planned stock was the result.

Storekeepers throughout the company's territory heard of the committee and its work and were encouraged to bring it items they had been unable to dispose of. Even though the committee turned "thumbs down" on retaining an item or piece of equipment, this might not mean its end as scrap. The stores department had on its staff a salvage engineer with an active and ingenious mind, and when he could not find a profitable use for something it was indeed time to scrap it and say, as does the

Keeping an eye on it

This chart shows a combination of the items needing the closest watching. Occasional study of such a chart will supply an excellent guide to the condition of the material and supplies account and will answer many executive questions that may be directed to those in charge of such materials.



packing house industry, that all except the "squeal" had been utilized. Finally the "squeal" was captured and made to assist in reducing the book loss. The salvage engineer scrapped the surplus equipment and stock so well that we obtained better prices for the ferrous and non-ferrous scrap metals contained in them.

As an aid to the committee in its work of obtaining the best disposition for "left-over" materials, a catalog of surplus items was published. Constant revisions were made and its several sections kept up to date. Leftovers from construction and maintenance jobs were turned over to the stores department. These materials were then classified and listed in a catalog as pipe, pipe fittings and valves, wiring supplies, and conduit fittings, etc. About one hundred of these surplus catalogs were placed about the company in strategic positions. They were put in attractive, yet inexpensive, fabrikoid binders, and the published sections had such clear and complete descriptions that designers, construction and maintenance men found that to use these lists meant lowered costs for various small jobs. A rule of not charging construction and maintenance accounts for small items, say under $10 in value, saved much paper work and enabled the stores department to carry these odds and ends at zero value. This was a magnet that attracted all the Scotch-inclined in the company to the bargains seemingly offered. As a result of all these activities, the "write-offs" of obsolete and little-used stock were greatly minimized, yet very little material in an investment of well over $3,000,000 was idle.

In the table below is shown what these "write-offs" have been each year, the average stock balance and the per cent loss. This loss has been still further cut down by sales of such scrapped items, as they were, or in the form of ferrous and non-ferrous scrap metals:

Year	*Stock Write-Offs	Average Stock Balance	Per Cent Loss
1930	$26,600	$4,074,000	0.65
1931	45,000	3,743,000	1.20
1932	11,900	3,381,000	0.35
1933	11,100	3,108,000	0.35
1934 (est.)	10,000	3,000,000	0.33

*Note—This does not include all stock written off in a year, but only that portion that was scrapped. Another account is for stock written off and held for sale. The money loss on this account is, of course, not so great. For the sake of comparison only that class of stock that had lost practically all value was here considered.

Babson lists, as one of the requirements that should be met before investing in a corporation or enterprise, simplicity of routine. In other words, the minimum of red tape is a partial gage to efficiency, and hence ability to earn. The stores department of a large utility has such a large investment in stock that simplicity of routine is of the utmost importance if operating costs are to be kept at a reasonable figure.

Finally, a word or two on the stock budget set up by some managements as the "law of the land." These are mostly a waste of time. No one in possession of his senses should be asked to adhere to one. The best judgment considers at one extreme taxes and interest on money tied up in materials and supplies, and, at the other, the savings made by the purchasing agent in making bargains based on quantity purchases that more than save these costs. The braking action on large purchases is the cost of the annual "write-offs" for depreciations less the amounts obtained in salvage of such items. If the stock account is clean and free from such obsolete items and slow-moving stock, the management will seldom "ride" the stores department.

Free Lamps Cost Boston 2.67 Mills per Kw.-Hr.

An analysis of the cost of lamp service to all classes of customers receiving it under their particular rates without extra charge was recently prepared by the Boston Edison Company in connection with the pending rate case before the Massachusetts commission. Opponents of the company had asserted that the so-called free renewal policy represents a substantial burden per kilowatt-hour, this having been set up as from half a cent onward in earlier days of Bay State regulation. The latest tabulation reached a figure of 2.67 mills per kilowatt-hour, based on 1932 data as given below:

Average investment in lamps	$2,417,537
Number of lamps issued for renewals	3,860,608
Cost of lamp service:	
Lamp renewals	523,016
Installations disconnected	24,838
Investment costs at 9 per cent	217,578
Total	$765,432
Energy sold at prices including lamp service	Kw.-hr.
General rate "A"	99,591,991
Less energy sold without lamp service	3,564,393
Total energy sold with lamp service rate "A"	96,027,598
Residence rate "B"	179,204,943
Yearly lighting rate "C"	2,905,483
Estimated company use (cost of lamp renewals includes furnishing company lamps	8,000,000
Total energy sold with lamp service	286,138,024
Average cost of lamp service per kilowatt-hour, mills	2.67

By F. H. PENNEY
Industrial Engineering Department,
General Electric Company, Schenectady

With Built-in Motors

Placing the motor so close to the work that its shaft becomes the work spindle makes the motor a built-in part of the machine. Such intimate co-ordination of power and what it drives calls for equal co-ordination between the machine designer and the motor builder.

Unless this is done there will be troubles from inadequate ventilation or insufficiently delicate balancing. Also, the control mechanism and the push-button units deserve corresponding attention if the built-in concept is to be carried to its full possibilities.

The trend is all that way. Precautions must be observed if the trend is not to meet reverses here and there for both the designer and the user of the motorized equipment.

BUILT-IN motor and control applications to industrial machines necessitate close co-operation between the machine designer and the electrical manufacturer. Particularly is this true as the driving units are placed closer and closer to the work point. Co-ordination is especially necessary as to ventilation, dynamic balancing and disposition of the control equipment.

When a motor shaft serves for both the rotor or armature and work spindle, and in addition end shields or end fraes are common parts of the driven machine and motor, the location of the motor on the machine and its position are fixed by the spindle requirements. It is coming to be more completely recognized that the individually motorized spindle and the multi-motored machines are entirely justified, not only from the efficiency point of view, but from the standpoint of first cost and maintenance.

The flange-mounted motor has sometimes been referred to as a built-in motor, though essentially such a motor is a unit of general purpose construction. However, the flange-mounted motor is frequently so well adapted to machine drives that it may well be included as one of the built-in motors.

Provision for ventilation essential

Ventilation is one of the very important considerations when a motor is to be built in, particularly if the mounting space is restricted at one or more points. When motors are purchased, "rotor and stator," with the idea of having the machine designer apply the end shields, shaft, bearings, etc., a substantial part of the ventilation problem falls to the lot of the machine designer. He is at liberty to arrange the assembly so that the rotor will provide the ventilation without auxiliary fans or to modify the mounting better to suit his own requirements or design and then provide an auxiliary fan in lieu of the rotor fans. This procedure is quite acceptable, but it should be borne in mind that one of the two alternatives is usually essential.

Motors intended to work on a continuous basis must have a reasonable supply of ventilating air. The source is unimportant, but it is desirable that it be uncontaminated by dirt or gases. Usually rotor fans best serve the purpose of providing this air and fans integral with the rotor are decidedly advantageous, since their arrangement will then usually provide cooling air for both the rotor and stator. In many cases rotor ventilation is entirely neglected by designers. The salvation of many an application has been that the spindle was overmotored, heat not being developed in proportion to actual capacity. There are, however, applications where normal load on the motor would result in temperature rises above normal due to lack of ventilation.

With a flange-mounted motor, either open or totally inclosed, fan-cooled, the ventilation is self-contained and requires no attention on the part of the machine designer. An examination of the ventilation incorporated in such motors will reveal that a careful arrangement of design has led to a simple, positive and inexpensive ventilating arrangement which is effective for both the rotating and stationary parts.

Air discharge best at work head

There seems to be frequent necessity of either locating a motor between two parts or of passing the whole unit between supports or ways during the assembly or disassembly. The motor builder should be, and usually is, ready to meet a machine designer at least half way, therefore it should be possible to meet the motor requirements without material penalty on the part of either the motor or machine design.

It is difficult to give general rules for laying out a machine design, and therefore only a few general statements seem to be in order. Good practice indicates that for many, if not most, applications, especially of the built-in type, air should be discharged toward the work head. The air source should be uncontaminated and the air should be at room temperature.

A more or less rule-of-thumb method to go by in considering the amount of ventilating air required is to provide 10 cu.ft. of free air per minute for each horsepower of an open motor, while the fan-cooled motor requires about four times this amount. This is usually a liberal allowance and if followed, with the air reasonably distributed by various air passages over the whole motor, adequate cooling will be assured under severe load conditions.

Balance and vibration are closely related and are subjects to which every machine designer is giving anxious consideration. The question of balance or lack of it has often been discussed. Frequently the motor is blamed

Watch Ventilation and Balance

for a vibration which is set up, and probably the motor has been at fault in many instances. However, motor builders today are in a position to dynamically balance the rotating members very accurately. Simply balancing the rotor, however, does not necessarily insure that the finished rotating assembly will run without vibration.

The writer's attention some time ago was directed to a case of vibration on a high-grade tool driven by a four-speed induction motor. The careful balancing of all parts did not seem to eliminate the trouble, which occurred always at one intermediate speed. Very careful study finally revealed that the real seat of the trouble was that one motor speed coincided with the natural period of vibration of the structure which made up the mounting. At speeds either above or below the critical speed operation was entirely satisfactory. In fact, operation at 50 per cent above the critical point and at three times the critical speed was excellent. It is true that if the rotating system were in perfect balance dynamically the trouble would not have shown up. However, such a condition is difficult to achieve and is often prohibitively expensive.

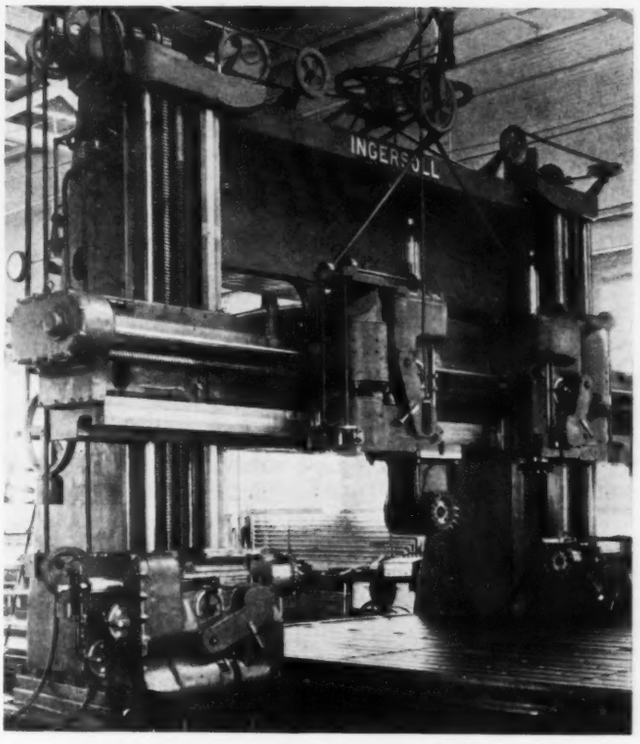
It seems that quite often instead of resorting to extreme measures with one element consideration should be given to the machine as a whole, whereby the resonant condition can be avoided.

Vibration may be started and maintained by some element of a machine which certain types of construction will amplify and others minimize. Therefore models of new machines requiring very considerable effort to reduce or eliminate vibration should have the design examined carefully for critical or resonant conditions. A modification in design at this stage might save many dollars by reducing the amount of balancing and testing necessary to secure a given standard. A small reduction in testing time per machine would be very effective from an economy point of view.

Free amplitude is the criterion

In case it is desired to purchase a complete motor dynamically balanced to within certain tolerances it may be necessary to specify the number of mils amplitude of vibration or fraction thereof which can be accepted, but it is equally important to know how the motor was supported when the readings were taken. Different amplitudes of vibration with a given motor will be secured on a wooden floor as compared to an iron floor or bench, and so on. The recommended method is to rest the motor feet on individual elastic blocks of rubber, so that the motor is free to vibrate at its natural period. The amplitude of vibration thus determined with the motor running at normal speed can be duplicated elsewhere and thus results checked.

Solidly bolting the motor to any object, unless it be the complete machine it is to drive, will probably give irregular results. It is suggested that, if a user has a very particular job, experiments be conducted with one motor mounted in place until satisfactory results are secured. The motor may now be removed and set up with each foot of the motor on a rubber block having a thickness of about 1 in. and an area somewhat less than that of the motor foot. The rubber should have a Shore durometer reading of less than 40. The vibration amplitude thus determined at the bearing housing or on top of the motor frame can be duplicated at the factory and thus a thoroughly satisfactory and mutual basis is established.

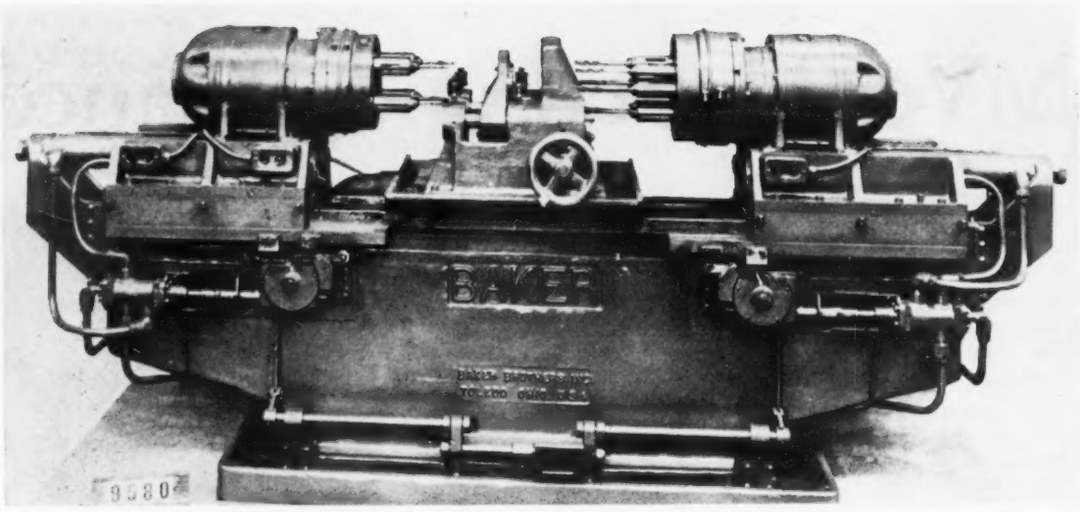


Milling machine heads and feed powered by individual built-in motors

Fan-cooled, d.c. adjustable-speed motors with magnetic control mounted in the cross-girt of the housing, drive this Ingersoll 15x12x40-ft. planer-type miller; 20-hp. 900/1,800-r.p.m. motor on the heads; feed driven by 25-hp., 500/1,500-r.p.m. motor, pumps by two smaller ones.

The frequency of the vibrating period can easily be determined by means of a Frahm vibration indicator held against the vibrating member. Such a device consists of a set of reeds of varying length mounted in a box and calibrated to respond to various rates of vibration. The scale opposite the reed vibrating with the greatest amplitude indicates the frequency of vibration. Such a device is simple, easily employed and gives direct readings. Some small and relatively light structure will vibrate when struck with the hand, others will respond only to a heavier blow. The vibration indicator, which is decidedly sensitive, will usually show the frequency of vibration in either case. Other structures may require operation of the motor or spindle to determine either the frequency or amplitude of vibration of the structure, if any.

It is obvious that if the natural vibration period of the structure corresponds to the motor speed trouble from vibration is almost sure to follow. How closely the two approach each other will depend upon many factors,



Flange-mounted head motors drive a two-way lead screw tapper

Each is a 5-hp., 1,200-r.p.m., fan-cooled, squirrel-cage motor with mounting feet; head flanged to motor end-shield.

among which are the permissible vibration amplitude and the vibration range. In some cases it may be desirable to stiffen the structure, thus raising the critical point, while others require that the critical point be lowered, thus relieving the unfavorable condition. If the critical point of the structure be lowered there may be a point where vibration will occur during acceleration or deceleration, but it is likely to be of short duration and not of much consequence. On the other hand, if we resort to raising the vibrating point it may be very difficult to so design the unit that the responsive point will be above the operating speed.

It is therefore desirable that the motor builder be in position to balance accurately his rotors and armatures. This part of the problem is strictly up to the electrical manufacturer, but bear in mind that while this is a step in the right direction, it is only a step. The rotating system must be dynamically balanced as a whole and the structure so designed that resonance will not occur at the operating speed.

Space for control should not be overlooked

Built-in magnetic control may be located where space exists within the machine without in any way affecting the efficiency of the machine or its ease of operation. One of the problems of the application engineer has been to try to secure sufficient space in which adequate control units can be housed within the machine. Particularly is this true on machine tools where instead of a complete redesign a partial revamping takes place with the expectation that somehow the control can be worked in. Machines of entirely new design, however, usually will have a reasonable space provided for the control units.

On double-ended machines it is quite feasible, where necessary, to segregate the motors and control and run only such interconnecting lines as may be necessary for interlocking, etc. Thus a conduit between the two groups permits the various and corresponding control units of a group to function equally as well as if they were adjacent to each other. Such possibilities sometimes will permit the building in of control units because the size of individual control groups can be kept small. The cost of control wiring may be increased a trifle, however, by segregating the various units. This may be offset, however, by the fact that the power-carrying conductors as distinguished from control circuits will require shorter runs.

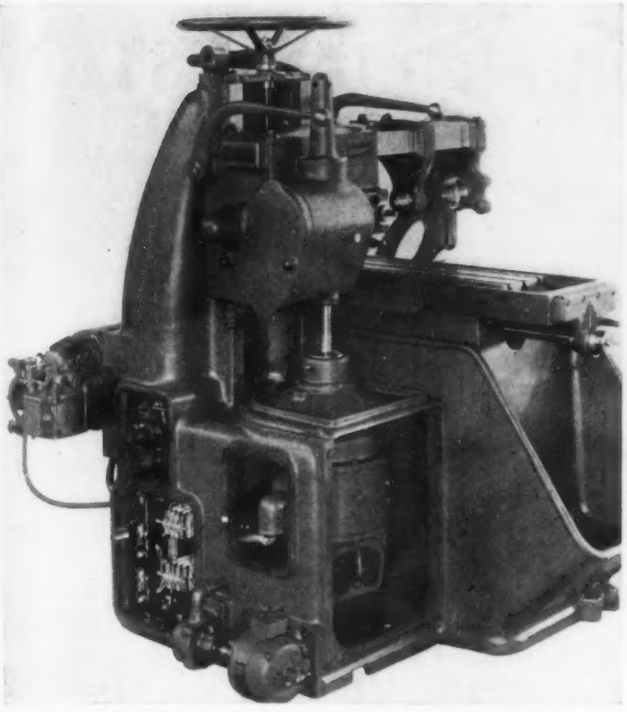
The control circuits are light, easily handled and disposed of; moreover, they can be run in flexible conduit within the machine frame very readily. Circuits passing through compartments containing cooling or cutting compounds or where mist or spray conditions prevail should be properly protected. The general purpose BX conduit is not adequate for such conditions. There is a type BX conduit which is suitable, the insulated conductors of which are first sheathed with lead and over this the usual flexible BX is laid. Such duct may pass through water or be subjected to continuous spray without detriment to the insulation. There is also now available on the market a seamless type of duct, resembling ordinary conduit and serving as such. It is fabricated, however, from a material which makes it feasible to bend it around so that the contour of the machine may be closely followed. The appearance is considered superior to BX for some applications, particularly where other pipes are necessary for lubrication or to carry cutting compounds.

Only a very few machine tool jobs involve temperatures high enough to injure the ordinary standard insulations. In view of the very great variety of machines to which both motors and control are applied, occasionally abnormal temperature conditions arise, and these require special consideration. It is desirable to obtain recommendations from the manufacturer of electrical equipment, preferably after an engineer has had the opportunity of looking over the conditions involved.

Machine serves as housing for control

Built-in control for multi-motor jobs is frequently made up of standard units grouped together so as to secure the requisite functions. Control devices normally are inclosed in sheet or cast-metal boxes. For most applications where control is built in, however, the machine housing serves very well in place of the ordinary inclosing case and is normally acceptable if the control is properly mounted. It is customary to omit the usual inclosing case when units are located in machine compartments.

Push buttons for operating magnetic control are available in wide variety of forms which can be adapted, with only minor changes, to meet most operating conditions. It is sometimes feasible to mount a complete push-button station where it is not desirable to extend the machine frame for building in. General-purpose stations, now available, conform reasonably well to the normal con-

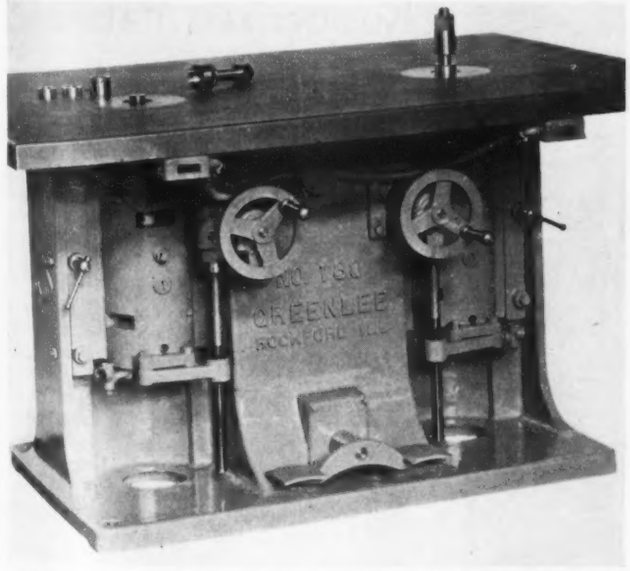


Separate motors used for miller spindle and feed
This Sunstrand Electromill is operated by 3-hp. d.c. cutter motor and 2-hp. table motor. Controller housed in base of machine. Pump motor ½ hp.

tours of the machine and may usually be located with respect to convenience of operation without marring the general appearance.

However, where conditions permit, the back-connected push-button station with only the cover plate and the operating buttons on the surface, the latter clearly marked by neat nameplates, certainly provides a good-looking, reliable and efficient installation.

Today the trend seems to be for unit construction of push buttons as for other apparatus. To this end the button proper with its mechanism is of self-contained type. Therefore, for large multi-motor jobs or where unusual combinations are wanted they can be built up from standard units. Unless space is at a great premium the general-purpose unit type button is suggested, which includes normally open and normally closed contacts both of the wiping type. For greatly restricted spaces smaller units are obtainable.



Completely built-in drive for double-spindle shaper
Even wiring is inclosed, as well as two drawn-shell head motors and their control.

Starters present small heat problem

Full-voltage starters for squirrel-cage motors may be closely housed usually with little provision for ventilation, since the heat developed under average conditions is very limited. The operating magnet of the switch radiates only a very few watts, and the same is true for the contact tips when the circuit is made and broken, though where frequent reversals are the rule considerable heat may show up as the circuit is being made and broken under load conditions which materially raise the heating of the contact tips. The use of thermal overload relays in unduly restricted compartments may require a little consideration. Temperatures caused by this type of control, however, are seldom a factor, since the total developed heat per unit is small and the machine structure usually radiates the energy with a negligible temperature rise.

Direct-current control sometimes must be watched a little more than full-voltage a.c. control because of certain inherent features, the principal reason being that resistance type starters are largely used. For very infrequent starting, unless the motor is large, the total heat is not a serious item. However, where operations call for the frequent use of the starting resistance the total heat developed may require positive means of ventilation, such as louvers, top and bottom, or other means of allowing the temperature rise to create a draft of air. Extreme cases may require other means of ventilating, but these are rare.

Power-Factor Chart Simplifies Readings

By T. A. ROGERS
Instructor in Electrical Engineering, University of California, Berkeley

It is sometimes desirable to test a synchronous machine at some particular load and particular power factor. If an accurate power-factor meter is available the test presents no difficulties. When a power-factor meter is not available the power factor may be calculated for each field setting of the machine and the desired power factor approached by successive approximations. This procedure takes quite some time, and if many tests are to be made time may be saved by using the accompanying chart in adjusting the power factor.

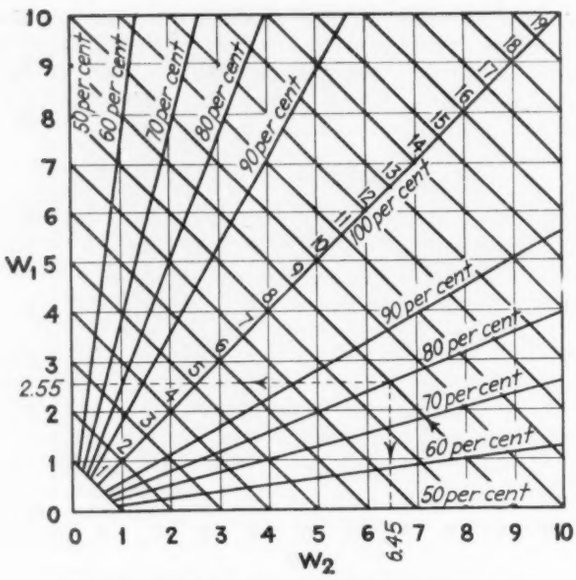
When two wattmeters are used to meter power in a balanced three-wire circuit the relation for power-factor angle is

$$\tan \Theta = \sqrt{3}\,\frac{W_1 - W_2}{W_1 + W_2}$$

Which may be reduced to

$$\frac{W_1}{W_2} = -\frac{\tan \Theta + \sqrt{3}}{\tan \Theta - \sqrt{3}}$$

For a constant power-factor angle the ratio of W_1 to W_2 becomes a constant and if values of W_1 and W_2 are used as co-ordinates the ratio is a straight line through



Any power factor established by control of two wattmeter readings

The use of this chart may be best discussed by means of an example. It is desired to adjust to 80 per cent the power factor of a machinecarrying a constant load at some other power factor. The total load, $W_1 + W_2$, is, say, 9.00, and $W_1 = 4.00$ and $W_2 = 5.00$ under the existing conditions of 98 per cent power factor. Entering the chart to the total power line 9.00 and following this line to the intersection with the 80 per cent power-factor line results in readings for W_1 of 2.55 and for W_2 of 6.45. The field of the synchronous machine may now be adjusted until the wattmeters have these readings.

the origin. The accompanying chart shows a group of these constant power-factor lines. Lines of constant total power are also drawn on the same chart.

The accompanying chart has been constructed for the range between 50 per cent leading current and 50 per cent lagging current, but may be extended to cover the entire range between 0 per cent lead to 0 per cent lag if desired. The power-factor lines will then lie in the second and fourth quadrants. However, since the excitation of the synchronous machine determines whether the power factor is leading or lagging, it is unnecessary to construct the chart for both cases. The values of the wattmeter readings are simply interchanged.

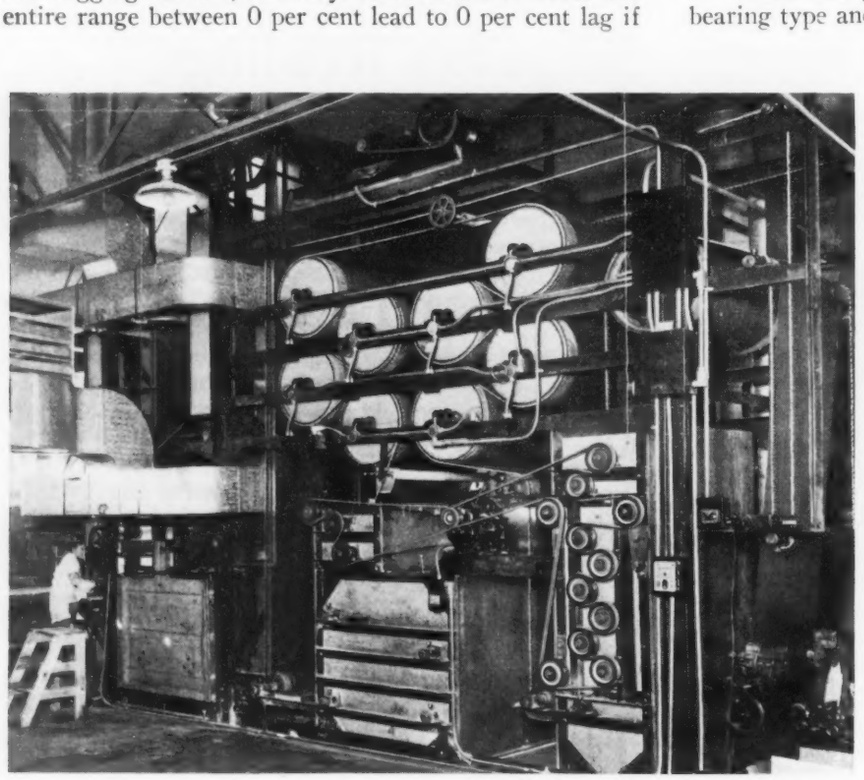
Ball-Bearing Motors Cut Pottery Costs

By FRANCIS A. WESTBROOK
Consulting Engineer, Brooklyn, N. Y.

Shut-downs for replacements eliminated, as has been the necessity for frequent oiling. Minimum saving of $5 a year per motor estimated

While there is probably no unit of industrial plant equipment which is less subject to trouble under ordinary operating conditions than the induction motor, there are certain circumstances where they are run for long periods of time continuously or in dust-laden atmospheres when trouble does develop in the bearings if of the plain babbitted type. This was the experience of the Mount Clemens Pottery Company, and as a result it has adopted ball-bearing motors as standard. This decision will have a meaning to those who are contemplating plant modernization at this time with a view to reducing costs and improving efficiency.

At least 80 per cent of the motors are of the ball-bearing type and something like 90 per cent of all drives



Rubberized Fabric Made Electrically

Automatic production, by the use of electricity for heat and motive power, is well exemplified by a new machine for making "Lotus cloth," a new waterproof fabric, in the plant of Rubberized Fabrics, Inc., Kansas City, Mo. Six motors, the largest being 2 hp., are used to drive the machine. Each of the eight large steel drums is equipped with two 500-watt strip heaters and an automatic temperature controller. Silk cloth, traveling over rollers, is impregnated with liquid rubber, dried in first drying chamber, washed in water tank, dried in second drying chamber, coated with mica dust or talc (depending on finish desired) in dusting box, tempered by passing over electrically heated tempering rolls, brushed in the finishing chamber and rolled onto rolls at the end of the machine. Electric service, supplied by the Kansas City Power & Light Company, is employed for power and heat.

PRACTICES IN BRIEF . . .

in this fully electrified plant are individual. The machinery includes blowers, driers, conveyors, molding spindles, high-pressure reciprocating pumps, etc. All of the motors are of the induction type and range from ½ hp. to 10 hp. in size.

Some of the motors are located near the drying machines, where the temperature of the surrounding atmosphere is as high as 120 deg. F., and others are in the slip room, where the air is heavily laden with dust. One of the pump motors and one of those driving a blower operate under normal conditions for 24 hours a day, seven days a week. Each of these has been run as long as 11,000 hours continuously. None of these motors have given any trouble since adoption of ball-bearing types, but when sleeve-bearing motors were used the average life of the bearings was about one year for those of 5 to 10 hp. rating and two years for those of smaller size. Bearing failures were not only a source of expense from the replacement standpoint but the interruptions which they caused in production schedules and the lost time of operators who were made idle was a much greater source of waste. In addition it was necessary to oil every motor every day, but in spite of this precaution it was not possible to avoid the necessity of replacing bearings on the average at least as often as mentioned. The cost of these replacements amounted to approximately $260 a year for 54 motors. This represents a saving to be credited to the ball-bearing motors. No attempt has been made to place a dollars and cents value on the savings in power due to decreased friction losses or in lubricant maintenance.

Portability Extends Babbitt Pot Usefulness

By GEORGE H. HALL
Consulting Engineer, New York

By taking advantage of the flexibility permitted with electrically heated, soft-metal pots one large shop has gained economies and efficiencies

So far as the melting of babbitt and other soft metals is concerned the electric pot has long since proved its merits in cleanliness, efficiency and convenience. Now, in a large service shop, we find it demonstrating a further advantage, that of portability. Although the particular section of the shop shown has been set aside especially for pouring bearings, in cases where the work cannot readily be brought to this section it may be more convenient to take the pots to some other part of the shop where they can be plugged into any available electric outlet and the work performed at the point desired.

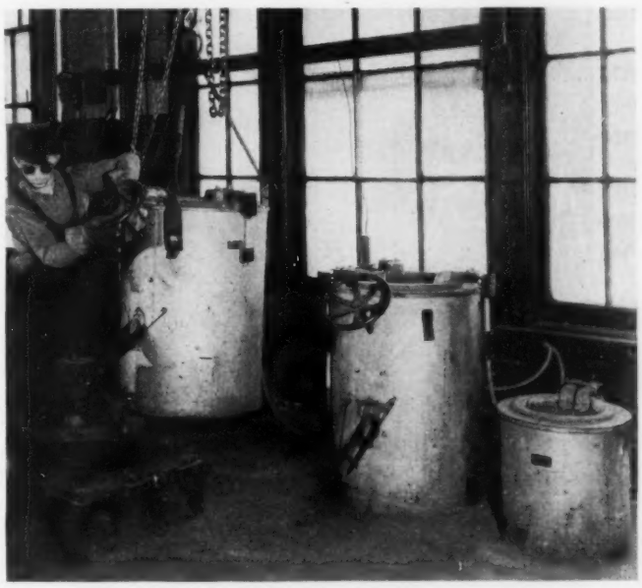
An advantage of the larger pots, and one that greatly adds to their value and convenience, is that the melted metal can be poured from a spout. This permits the complete pouring of a bearing in so short a time that the metal is all run at practically uniform temperature.

If the metal for a bearing of large size is ladled from the pot to the bearing by hand the process is necessarily slow and that part of the babbitt first poured has time to become well cooled before the last is ladled in. This difficulty is entirely overcome by the spout-equipped, electrically heated pot.

In relining bearing shells with the equipment the shell is placed on a cast-iron plate and the mandrel set in position. Both shell and mandrel are then heated by gas flame to a temperature practically the same as that at which the babbitt is to be poured. Also, a large gas burner is kept blazing underneath the plate during the period of preheating and that of actual pouring.

When preheating is completed and the metal in the pot has attained proper working temperature the electrical connctions are broken, the pot is lifted by the crane and swung directly into place above the bearing. By a turn of the handwheel the spout is opened and the metal run into the mold. When a bearing lining has been cast in this way it will stick permanently to its shell and trouble caused by loosening of linings is avoided.

The process described seems easy. It is. Just how easy is shown by an actual case of repair work which came into this shop one night when but one workman was available to take care of it. A large bearing had to be relined and it had to be completed by the following morning. With this equipment it was finished on time by this man, although the lining had a weight of 1,500 lb. exclusive of the weight of the riser. The actual time of running the babbitt, after the metal was set up and the metal melted, was but 22 minutes.



A corner of a service shop with three electric pots for relining bearing shells

Pots are located beneath the hand crane which takes them from where they are heated to the point of pouring. Two of the G.E. pots have a 1,000 lb. capacity and the smaller 330 lb. The larger ones have three heating units of total capacity of 15 kw. per pot and the smaller two units of 5 kw. total capacity. The smaller pot has no spout as it is for small work where ladling can be done.

Energy Use Shows Gain, South and West

In both the South and the West January operations averaged 15 per cent higher in 1934 than in 1933, but in the South they have been slackening somewhat, whereas they have held firm in the West for the past half year with minor fluctuations.

The South's most important manufacturing industry—textiles—suffered a sag in December, but this has been followed by a mild rise. In forest products, however, a decline has been in progress for several months and January was 22 per cent under October, leaving only a slight residual gain over the first month of 1933. The industry is still on a low plane compared with years in which construction work was active.

Meanwhile the index for iron and steel is 40 per cent higher than last spring, ignoring the extreme dip in March, and 65 per cent up from January, 1933; the corresponding gain in the metal-working industry is 44 per cent. Food products is in its winter stage, on the same level as at this season last year, though lower than in autumn. The industry is one that has never, during the entire period of the depression, dropped in any such degree as, for instance, the metal and lumber industries. Apparently responding to the demand of the automobile plants, rubber products jumped 33 per cent compared with December.

In the West the average has climbed more steadily than elsewhere from the low point late in 1932. All lines are more active than at this time last year.

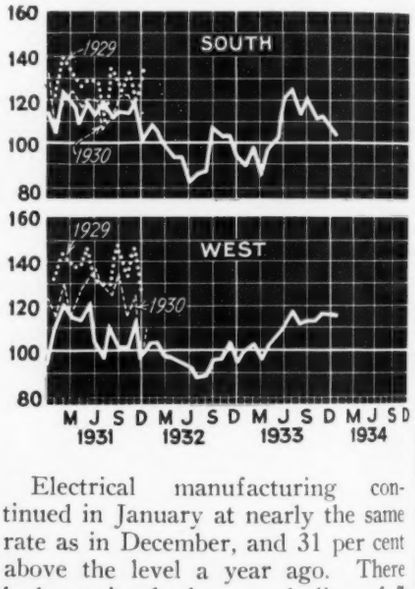
Index of monthly manufacturing activity, South and West

Base: Average month 1923-1925 = 100

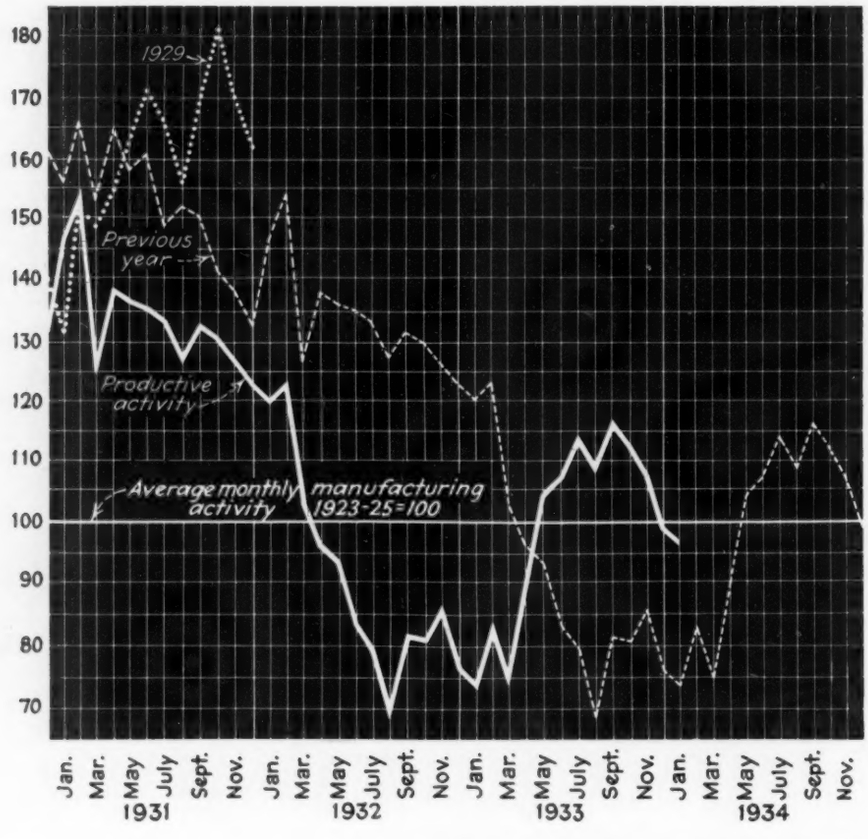
(Corrected for number of working days, but not for seasonal variation)

	South					West				
Industrial groups	Jan., 1934	Dec., 1933	Nov., 1933	Oct., 1933	Jan., 1933	Jan., 1934	Dec., 1933	Nov., 1933	Oct., 1933	Jan., 1933
All Industry	**103.3**	**107.5**	**113.3**	**112.0**	**90.1**	**115.2**	**115.3***	**116.9**	**113.3**	**100.0**
Chemicals	154.4	182.0	166.1	163.3	132.7	90.8	92.7*	86.0	91.2	78.2
Food products	127.7	127.8	153.6	161.5	128.0	122.8	116.3*	118.9	111.3	116.2
Iron and steel	135.1	140.6*	110.8	110.3	81.7	....	....	....	....	....
Metal working	85.4	93.8	82.5	90.0	59.3	....	....	....	....	....
Metals group	113.2	120.0*	98.8	101.3	71.8	73.2	77.5*	76.3	75.3	44.6
Lumber	39.4	40.8	46.3	50.8	36.6	152.0	156.7	162.8	155.3	145.7
Paper and pulp	152.2	164.0*	173.8*	176.6	128.1	145.6	129.4*	135.0	145.4	138.4
Rubber products	102.6	77.0	69.5	102.8	57.3	80.7	84.0*	97.5	92.5	76.2
Shipbuilding	....	....	....	....	....	126.8	118.0	123.0	114.0	107.3
Stone, clay and glass	95.3	85.4	109.0	60.4	70.7	117.5	122.3	120.0	118.2	78.0
Textiles	112.2	108.8	123.1	120.0	101.5	....	....	....	....	....

*Revision



Appliance Manufacture Speeds Up



Electrical manufacturing continued in January at nearly the same rate as in December, and 31 per cent above the level a year ago. There had previously been a decline of 7 per cent from November. The comparisons are based on monthly reports to ELECTRICAL WORLD of energy consumption in that type of industrial establishment.

In the very largest plants, considered as a group, operations have not greatly varied in several months, though the trend has been downward rather than level or rising. The smaller concerns, in the aggregate, slackened rather sharply in December but their activity was subsequently accelerated.

Monthly Index of Electrical Manufacturing Activity

Adjusted to 26 working days

Base: Average Month, 1923-1925

	1931	1932	1933	1934
January	146.6	120.0	74.0	97.1
February	154.3	122.2	83.3	....
March	126.1	102.9	75.0	....
April	138.1	95.6	89.4	....
May	136.7	92.8	104.1	....
June	135.2	83.1	106.9	....
July	133.4	79.2	114.0	....
August	126.9	67.6	108.4	....
September	132.6	81.4	115.2	....
October	130.4	80.9	111.7	....
November	126.9	85.6	107.0	....
December	123.5	76.0	99.4	....

LETTERS TO THE EDITOR

Simplified Meter Mountings Under Study by E.E.I.

To the Editor of the ELECTRICAL WORLD:

The many articles* which have recently appeared in technical publications pertaining to meters and their associated mounting or inclosures and on the diversion of energy indicate a wide interest in advancing the status of these practices. Your editorial of May 20, 1933, shows a grasp of the present confusion in the meter mountings situation. The article in your December 30, 1933, issue presents a more complete picture of this confusion. A study of all these articles is convincing evidence of the need for standardization.

Toward standardization considerable has been accomplished. The meter as a measuring device is and has been, to all intents and purposes, standard. The characteristics of all domestic makes are very similar. Ratings for self-contained meters have been standardized. Mounting of the meters, or the method of connecting them to the wiring system, has, however, varied widely. This has been due to the fact that meters in the past have been designed to accommodate open wiring systems, whereas present-day requirements very definitely indicate that they must be designed for inclosed wiring systems. As the change from open to inclosed wiring systems progressed developments in meter cabinets and inclosures provided a means of accommodating an open wiring device, the meter, to an inclosed wiring system. This has proved to be an unsatisfactory compromise.

Inclosure discourages diversion

In addition to this demand for a method of connection in keeping with the changes in wiring there is the need for an inclosure or mounting method that will effectively discourage the diversion of energy.

The advantages to be gained by consolidating and bringing meter mounting practices down to date can be summed up briefly as follows:

1. Protection against diversion.
2. Lower cost installations for both the customer and the company.
3. Increased convenience with lower operating costs.

These discussions in the press and in committees have developed executive appreciation of the need for correcting a confused and uneconomic situation. Thus broadly prompted, the Edison Electric Institute has called on its electrical equipment committee to find the way to a satisfactory solution. This committee has two subcommittees, meter mounting, O. K. Coleman chairman, and energy diversion, A. J. Allen chairman, working jointly. A study of conditions and field requirements is being made, the results of which to date indicate a very general desire for interchangeability in mountings. Present offerings of the manufacturers fall short of this. This situation is not, of course, primarily the fault of the manufacturers, but instead originates in the diversity of designs demanded by their customers, the power companies.

There are two major objections to be overcome. All of the present offerings have either one or both. These are:

1. **Lack of uniformity.**
2. **High cost.**

The Edison Electric Institute now aims to co-ordinate the essential requirements. The outlook is promising, since the study to date indicates that there is practically unanimous agreement as to needs, in principle.

Co-operation toward unification

The next step will be the working out co-operatively with the manufacturers of the bases for unification of mounting design. Once this is done the manufacturers will be in position to overcome objections to the details of equipment now offered.

Meter mounting requirements to meet present-day conditions are fairly well understood by all meter men, but may be reiterated here for others interested:

1. Simplification and low cost.
2. Mounting to be designed for inclosed wiring.
3. All manufacturers' meters to be interchangeable.
4. Meters to be interchangeable for indoor and outdoor installation.
5. Elimination of auxiliary cabinets.
6. Service wires and terminals to be non-accessible outside of meter.
7. A minimum of test facilities.
8. A maximum of safety for meter installer and tester.

Study has shown that it may be difficult, if not impracticable, to get a new design meter mounting to meet all of these essential requirements and at the same time accommodate the older style of meters without remounting the meters into new cases.

Cost is, of course, an important consideration. Some cabinets or inclosures at the present time are high in cost, but it is believed that a new combined meter and its mounting can be produced for a cost not to exceed the cost of the least expensive.

The present situation may be summed as follows:

Manufacturers recognize a need for a revised meter mounting, and toward this end are offering certain designs, not interchangeable. They are anxious to meet the requirements of their customers.

Utilities appreciate the need for a new interchangeable mounting; they agree in principle on their requirements for a standard and have ideas on the amount that can be spent for such a mounting.

From this stand a solution is believed not difficult or distant.

A. E. SILVER,
E.E.I. Electrical Equipment Committee Sponsor, Meter Mountings and Energy Diversion.

*ELECTRICAL WORLD—"Simplifying Adequate Service to the Home," by H. P. Sparkes, October 15, 1932, page 538; "N.E.L.A. Meter Committee Considers Outdoor Metering," February 4, 1933, page 146; "Reducing Energy Diversion," by M. T. McKenzie, March 18, 1933, page 356; "Universal Socket for New Sequence Meters," April 1, 1933, page 432; "Need for Simplified Meter Installation Is Urgent" (editorial), May 20, 1933, page 635; "Diversion Thwarted, Unity Offered in New Meter Assemblies," December 30, 1933, page 852.
"New Meters are Interchangeable," *Electric Light and Power*, January, 1934, page 24.
"Outdoor Meter Installations and Suggested Form of Housing for Outdoor Meters," *E. E. I. Bulletin*, May, 1933, page 35.

THIS WEEK'S NEWS

E.E.I. Calls Meeting to Amend Constitution

At the suggestion of NRA officials the board of trustees of the Edison Electric Institute has approved and recommended for adoption an amendment to its constitution which will more distinctly and definitely state the grounds on which an applicant may be refused membership. The amendment, an addition to Article III, reads as follows: "Section 6: Until July 1, 1935, the Institute shall elect to membership any company applicant who is otherwise eligible and who agrees in writing to comply with the provisions of Article IV hereof; and during such period, expulsion from membership shall take place only for violation of Article IV hereof."

Article IV referred to in the proposed amendment deals with business principles, including the publishing of annual reports by the company members, the furnishing of accurate date to consumers, stock exchanges, and stockholders and to board of trustees of the Institute when requested. The article also stipulates that all contracts between any member companies which involve the furnishing of management, supervisory, purchasing, construction engineering or financing service to operating electric utility companies shall so operate in practice that charges to the operating company shall be reasonable and commensurate with the value of the services rendered and with the fair cost to the company furnishing the services.

Approval by a two-thirds vote of the company members will be sought at a special meeting on March 22 as required by the constitution of the Institute.

Invention as Job Creator Discussed by Scientists

Demonstration of the usefulness of science in increasing employment featured the meeting held this week jointly by the New York Electrical Society and the American Institute of Physics. Dr. Karl Compton, chairman of President Roosevelt's Science Advisory Committee, and president of the Massachusetts Institute of Technology, told of the many ways in which research and invention have created new industries which in turn have resulted in employing hundreds of thousands of people.

Besides Dr. Compton, other distinguished speakers took part in the meeting, including Dr. R. A. Millikan, well known scientist, and Dr. Kettering, famous director of research for General Motors. The New York Museum of Science and Industry also co-operated by setting up a special free exhibit of fundamental inventions showing the millions of man-hours of employment which each such invention has produced.

Supreme Court Refuses Appalachian Decision

Refusing to pass on the right of the Federal Power Commission to license power plants on non-navigable streams, the Supreme Court this week left the development of the Appalachian Electric Power Company on the New River in Virginia still in a legal tangle. The company challenged the authority of the commission over small streams, objecting to a clause in the licenses granted by the commission which allows the government the right to purchase the plant at the end of the license period. Early this month the Attorney General of Virginia filed in the Supreme Court a brief supporting the Appalachian company in its challenge of the commission's authority (ELECTRICAL WORLD, February 10, page 241).

The refusal of the court to pass on the case was in line with its rule not to give advisory opinions. No actual construction had been begun by the company when the suit was filed, although it had spent about $1,500,000 in preparing to build the plant. The government has announced it will at once file suit if the company begins work without a license.

Due in large part to the falling off in consumption, the power industry of this state [California] finds itself with production facilities substantially in excess of present demands. The now existing power surpluses will be augmented with the coming of power from Boulder Dam and perhaps from other sources. Either the industry must absorb and put to use these present and prospective surpluses or an examination into capital structure will become necessary, since the existing consumers may hardly in justice be expected or required to pay indefinitely a full return upon excess facilities, even though such facilities were provided initially in good faith.

CALIFORNIA RAILROAD COMMISSION

In a decision granting the San Joaquin Light & Power Corporation and the Midland Counties Public Service Corporation the right to inaugurate promotional and experimental rate schedules ("Electrical World," February 10, page 234) the commission issued this warning to the power companies of California.

87-Kw. Experimental Home Shows Load Possibilities

An experimental home laboratory having a connected load of 87 kw. and using approximately 1,500 kw.-hr. per month has been erected at Mansfield, Ohio, by the Westinghouse Electric & Manufacturing Company so that engineers, architects, manufacturers and home economists and their families can make actual living tests. It is an eight room, two story brick veneer house that would cost ordinarily $12,000, and is mechanically and electrically equipped as a servantless home.

The house is developed around the electric kitchen and laundry and is equipped with a "weather" room, replacing the furnace room, which contains air-conditioning cooling and heating equipment. Duct system air conditioning is used, with a steam boiler supplying the heat except for the penthouse, which has direct radiant electrical heating. All appliances of kitchen and serving pantry are concealed in sliding compartments when out of use. Automatic circuit breakers are used throughout. Nineteen built-in motors of 108 hp. rating are used.

This project using 1,500 kw.-hr. per month represents food for thought for utility men seeking new load, for if 3½ per cent of homes now wired were so equipped it would mean the exact doubling of the national consumption of electrical energy for purely domestic purposes.

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New Gas-Electric Bus

Experiments to demonstrate the practicability of operating a gas-electric type bus by electrical energy taken from trolley wires as well as by that from its own generator, have just been conducted by engineers of the Public Service Co-ordinated Transport of New Jersey. A regular 30-passenger city type bus was provided with a double trolley pole mechanism and retrievers and control so that bus could operate from either its own or trolley power. This type bus can run faster, quieter, and more economically where wires can be conveniently located.

Michigan Commission Ousted by Governor

Carrying out his threat to make a complete sweep of the membership of the state Public Utilities Commission, Gov. William A. Comstock of Michigan last week ousted the five members composing that body. When Commissioners Kit F. Clardy and Harry C. McClure failed to appear at the hearing the Governor ordered them dismissed at once, and later in the day he completed the ousting of the entire body.

Earlier in the week Mr. McClure had obtained a temporary injunction restraining Governor Comstock from continuing removal proceedings from Judge Charles B. Collingwood of the Ingham Circuit Court. The basis of his complaint was that he had not been given reasonable notice to defend himself against removal, having been notified of the action against him only five days before the date set for a hearing. His attorney maintained that the charges are so vague and ambiguous that it would be impossible to prepare an adequate defense within the few days allowed by the chief executive.

In a letter to the Governor before the hearing Commissioner Fitzgerald declared: "I am prepared to refute these charges, and in doing so I demand sufficient time during the hearing to produce such witnesses and data as I deem necessary for my defense. But I wish to protest against any 'stop-watch' investigation of these matters . . . The people of Michigan are entitled to all of the facts in this controversy. They cannot be brought to light in one or two days, and I insist on having adequate opportunity to present my case in full . . ." At the hearing Mr. Fitzgerald made another lengthy self-defense.

New Importance of Cable Sheaths

CABLE sheath improvement has now stolen the spotlight from dielectric evolution. Sheath troubles have multiplied and research on it is accelerated, but the answers are still to be found. T. F. Peterson, American Steel & Wire Company, urged the members of the New York A.I.E.E. Section Power Group at a meeting in Newark last week to discard the idea that radial top and bottom welds resulting from the lead press action are a source of later splits or failures. He proved the contrary by detailing the press process and showing tensile test section with necking almost invariably at other points. Nor does the stop for recharge make for an abrupt discontinuity in sheath characteristics, the fusing being distributed over most of the next length sheathed. This he demonstrated by a multiplicity of cross-section photographs and photomicrographs. His prophecy was that improvements in both cable fabrication and in installation and operating technique will reduce the frequency of cable failures substantially.

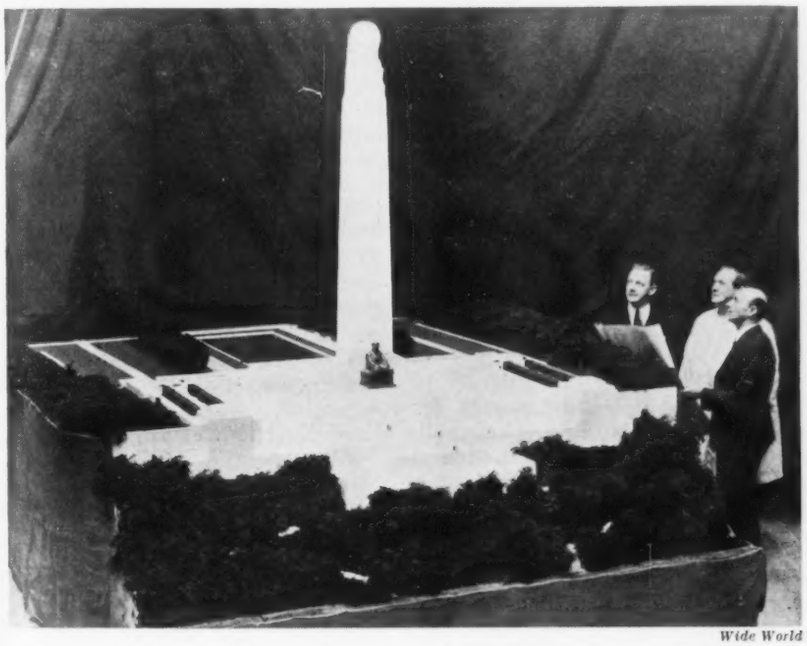
D. S. McCorkle, New York & Queens Electric Light & Power Company, felt the present muddle to be largely a matter of finding a short time test on which to frame specifications for sheath quality. Pulling tensions up to 9.6 lb. per duct foot with clearances of 0.4 in. and 1,000-ft. lengths in smooth duct have not been found harmful if sharp bends are avoided and pulling grease used. Bonding against corrosion should avoid conditions conducive to local electrolysis at the bond. Steep grades have caused trouble by oil and cable migration, but a wood clamp has been devised to hold the cable. In short, cable lead would present few troubles if it were not corrodible, conductive and relatively inelastic.

On the latter point, as well as on trouble with steep grades, G. E. Dean, Public Service Electric & Gas Company, dissented. No clamps are used on one 7.6 per cent average (10 per cent maximum) grade and observations showed no oil migration of consequence. Heavy, tacky rosin oil has supplanted reservoirs successfully. On aerial power cables expansion loops are omitted, as in telephone cable practice.

Thin sheaths an error?

Speaking generally, from the cable manufacturers' viewpoint, I. T. Faucett of General Cable Corporation reemphasized the stipulation that they must know internal pressures and pulling stresses and have a user's definition of normal lead before they can attain optimum results in fabrication. An adequate short-time test is still being sought. He deplored the fact that cable manufacturers, in spite of the prominence given to the mild epidemic of sheath failures, have no more operating data from the utilities than was available when the I.P.C.E.A. report presented last October was started two years ago. The trend toward thinner sheath is, in his opinion, entirely wrong, at least until reducing atmospheres and vacua for the lead bath and other remedial measures to control non-metallic inclusions have resulted in permanently better lead.

A $2,000,000 TRIBUTE TO EDISON?



Wide World

At Eagle Rock, in the Orange Mountains overlooking the Edison Laboratory and home at West Orange, N. J., the International Edison Foundation plans the erection of a $2,000,000 memorial tower and mausoleum as a tribute to Thomas A. Edison. Plans as approved by the Edison family call for a marble obelisk 350 ft. in height, tapering off to the outline of huge hands holding an incandescent electric light, thus symbolizing the inventor lighting the world. At the base of the obelisk is to be a bronze statue of Edison, and behind the tower a landscaped park. With the scale model are shown H. A. Kelly and J. B. Peterkin, architects, and Charles Keck, the sculptor of the proposed design to be financed by subscription.

Coming Meetings

Missouri Valley Electric Association—Kansas City, Mo., March 1-2. Thorne Browne, 1527 Sharp Building, Lincoln, Neb.

Oklahoma Utilities Association—Tulsa, Okla., March 6-7. E. F. McKay, 1020 Petroleum Bldg., Oklahoma City.

American Society for Testing Materials—Washington, D. C., March 7. C. L. Warwick, 1315 Spruce Street, Philadelphia, Pa.

Association of Iron & Steel Electrical Engineers—Youngstown, Ohio, April 12. J. L. Kelly, Empire Building, Pittsburgh.

Missouri Association of Public Utilities—Excelsior Springs, Mo., April 19-20. N. R. Beagle, 101 W. High St., Jefferson City, Mo.

Electrochemical Society — Asheville, N. C., April 26-28. Colin G. Fink, Columbia University, New York.

American Institute of Electrical Engineers—Northeastern District meeting, Worcester, Mass., May 16-18. Summer Convention, Hot Springs, Va., June 25-29. H. H. Henline, 33 W. 39th St., New York.

Edison Electric Institute—Atlantic City, N. J., June 4-7. B. F. Weadock, 420 Lexington Ave., New York.

Commission Permits City to Compete With Utility

For the first time in its twenty-seven-year history the Wisconsin Public Service Commission has authorized a municipality to compete with a privately owned public utility company when authorization was granted to the village of Hustisford. The decision was pointed to by the commission as probably marking the beginning of a new era in the public utility industry in the state.

In its decision the commission said that the private company, through excessive alleged investment in its property, was unable to render service at a reasonable cost. It was explained that under the law utilities are given a monopoly in communities served, subject to state regulation, except that the regulatory body can authorize competition when privately owned companies resist efforts to establish reasonable service at reasonable rates.

The Hustisford community plans to build a distributing plant for power purchased wholesale from Wisconsin Gas & Electric Company. The state commission ruled a few days ago that it is empowered to require a public utility selling wholesale service to serve an unaffiliated municipality or privately owned utility as long as the two are not competitors.

Federal Rate Quiz

Indorsement by the Federal Power Commission of the proposal by Senator Norris and Representative Rankin calling for compilation of information showing the electric rates throughout the country was announced at the House interstate commerce committee's hearings on the Rankin resolution, which, like the Norris resolution (ELECTRICAL WORLD, February 17, page 270), would direct the Federal Power Commission to make the survey.

Municipal Plants Indorsed by New York Board

In a report submitted recently to the state Legislature the New York State Commission for the Revision of Tax Laws made comprehensive recommendations for the establishment of municipal electric light and power service. "There are 53 municipal electric plants in New York State," the report said, "and investigation shows that they are frequently a source of revenue. The commission does not recommend that municipal utilities should be used as a source of revenue, but rather that they should be employed to furnish the indispensable services to consumers at the lowest possible rates and, incidentally, make a contribution to the local treasury.

"The adoption of comprehensive enabling legislation to give unmistakable authority to cities, villages, towns and counties to furnish electric light and power service is recommended by the commission. The decision to establish a municipal utility should be completely by local initiative. . ."

Incorporated in the commission's report are recommendations relative to the managerial organization; fiscal policy, including fixing of rates, and the relation to state agencies, including the problem of local taxation of the utility.

Lehman Utility Program Opposed by Cortelyou

Holding that several of the bills in Governor Lehman's utility program go far beyond the necessary powers for fair regulation of business, George B. Cortelyou, president of the Consolidated Gas Company of New York, has sent a letter to stockholders urging their consideration of the measures. Discussing the proposal to authorize summary rate reductions based on a return of not more than 5 per cent, he said the plan was contrary to all past experience and the decisions of courts. "If carried out as proposed," Mr. Cortelyou said, "it would require reducing and possible passing of the dividend on the common stock of this company and would depreciate the value of its preferred shares and bonds."

Mr. Cortelyou also expressed objections to the Governor's bill giving to municipalities the right to generate and sell electricity without Public Service Commission regulation, in competition with existing utilities. "If a city is to be given the right to go into the power business," he said, "it certainly ought to be required to take over at its fair value the service. It is inconceivable to me that a duplication of the enormous investment should be permitted, and I think that the people who invested their money in the present properties should have the right to be reimbursed for what would be destroyed."

Bankers oppose bills

Trust company officers of the New York State Bankers Association at a meeting held last week also expressed opposition to Governor Lehman's utility legislative program. In a resolution passed at the meeting they condemned the proposed legislation permitting the acquisition and operation of public utility plants and systems by municipalities in unregulated competition with privately owned utilities. If enacted into law, the resolution asserted, the legislation will destroy the value of securities of well-managed public utility companies in which hundreds of millions of dollars of trust funds are invested. Moreover, it was declared, enactment of such legislation in New York State would lead to similar legislation in other states.

Birmingham Stockholders Protest Profit Transfer

As the result of charges brought by preferred-stock holders that they have been defrauded, the Alabama Public Service Commission last week issued orders looking toward the attempted recovery, for the benefit of these stockholders and the depreciation account, of $3,200,000 paid by the Birmingham Electric Company to the National Power & Light Company, its holding company, as profit on the sale of the gas service department in 1929. The Birmingham Gas Company was then organized. Officials of the Birmingham Electric Company and the National Power & Light Company, the holding corporation, are cited to appear before the Public Service Commission at a hearing in Birmingham, March 20, to reveal details of the transfer of the funds.

Maintaining that they have been defrauded by the transfer of the profits on the sale of the gas utility to the holding company, the preferred-stock holders allege the profits should have been kept in reserve to pay dividends on preferred stock which have been passed in recent months. Among other charges is the allegation that the National Power & Light Company, sole holder of the common stock, paid $1,240,000 for this stock and has taken out $12,080,000 in the past nine years.

I. F. McDonnell, chief engineer for the commission, said the commission is "blazing a trail with this order." "If successful in its object it will establish a valuable precedent for the protection of ratepayers and investors in utility securities," he said.

Governor Balks at Firing Ohio Commission Chairman

Maintaining that the only causes given him by the laws of the state to justify removal from office are inefficiency, neglect of duty or malfeasance in office, Governor White of Ohio has refused to accede to demands for the ousting of E. J. Hopple, chairman of the state Public Utilities Commission (ELECTRICAL WORLD, February 17, page 272). After receiving Mr. Hopple's reply to the charges brought against him, the Governor, citing the legal requirements for removal, said: "With this as the polar star to determine the course of my action as chief executive of this state and without attempting to pass on the legal correctness of all the decisions that have been rendered by Mr. Hopple as a member of the state Public Utilities Commission, it seems clearly my duty to refuse to remove him on any evidence that has thus far been submitted to me or called to my attention.

In a brief message of appreciation Chairman Hopple said: "Permit me to say that I appreciate your confidence in me. You appointed me to the commission to do my duty and this I shall do in the future, as I have in the past. My decisions in matters before the commission will be rendered fairly, impartially and without prejudice and upon the law and the facts in the case." A resolution demanding Mr. Hopple's removal now is awaiting action by the judiciary committee of the House of Representatives.

New York Commission Charges Obstruction

In its annual report to Governor Lehman and the Legislature, released last week, the New York Public Service Commission charged that during the past year certain public service corporations through extended litigation have attempted to break down its efforts to regulate effectively the utilities under its jurisdiction. "Attacks have been made from so many directions as to give the appearance of a concerted effort by these companies," says the report. The report states that the commission has been required to appear in many more litigated cases than in any year in the commission's history and shows that in nearly all of these cases its counsel, Colonel Charles G. Blakeslee, has successfully upheld in the courts the determinations of the commission.

"The commission's efforts to fix temporary rates pending final determination of rate cases have, with two exceptions, been rendered fruitless by appeals to the courts," says the commission's report. "One of the most widespread and justifiable complaints against rate regulation is that pending proceedings require long delays and involve so much expense that practically no private complainant can afford to make a case and that public bodies have difficulty in obtaining funds. Further, if relief from high rates is attained, it comes so long after the time when it should have been applied that the public is disgusted."

Voluntary cuts urged

According to the report the commission considered 1,142 cases in 1933 and 666 of these were closed and 476 pending at the close of the year. "We confidently believe," says the report, "that if the utilities throughout the state were to make immediately further substantial reductions in their rates the amount of electricity, gas and telephone service would very greatly increase. Generally speaking, utilities have at present surplus plant, and as the increased service could be supplied at relatively low costs, the net income would be maintained or improved."

If the power industry meets just demands with a new wisdom suited to the new era of social service, and with complete candor and fairness; if it follows the statesman-like and liberal leadership within its own ranks and shows a progressive, co-operative spirit, rather than a reactionary and obstructive one; if it comes forward with constructive, practical proposals for the eradication of admitted evils, it may confidently expect the co-operation and support of public officials and the public they represent.

FRANK R. McNINCH,
Chairman
Federal Power Commission.

Warning the electric light and power industry that the public is relying upon the ancient rule, "by their fruits ye shall know them," for concrete evidence of a fundamental change in spirit, policy and purpose, Chairman McNinch last week clarified his own views.

Damage Question Put Before Wisconsin Board

Whether a municipality seeking to acquire a public utility which is privately owned must pay damages to the utility company as well as the cost of the property is the problem the Wisconsin Public Service Commission must solve. The question is involved in the cases of nine communities which have filed application to acquire the local distribution plants of the Wisconsin Power & Light Company and the Interstate Power & Light Company. The communities concerned are Shullsburg, Edgerton, McFarland, Fall River, Adams, Brooklyn, Friendship, Marion and Wittenberg.

Contending that damages to their properties as a whole resulting from the severance of the nine distribution systems would amount to $850,000, which is more than four times the total valuation of the property to be served as fixed by commission engineers, the utilities are demanding severance damages. The municipalities claim that no severance damages at all should be allowed and that the utilities should receive only the cost of the property acquired.

Municipalities present case

In representing several municipalities, Senator O. S. Loomis argued that when a municipality acquires a utility's local distribution plant the utility loses customers but no physical property, and that the constitution and statutes provide compensation only for the taking of property. William Ryan, counsel for the Wisconsin Power & Light Company, contended that if a utility's distribution plants are taken off one by one and the use of the generating system is reduced the question would arise as to where the utility could get its severance damages if they are not to be paid as they go along.

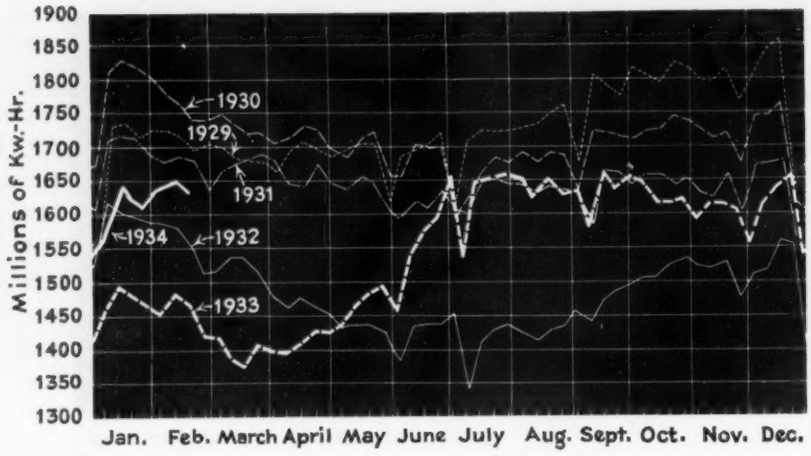
Navy to Buy Power Line

Authorizing the appropriation and expenditure of a sum not to exceed $42,079, a bill was introduced in the United States Senate last week by Senator Kean of New Jersey permitting the Secretary of the Navy to purchase from the Jersey Central Power & Light Company the transmission line, substation and other equipment on property of the Naval Air Station at Lakehurst.

St. Lawrence Vote Postponed

Administration senators have temporarily abandoned their efforts for Senate ratification of the St. Lawrence waterway treaty to make way for more pressing legislative matters.

Output Holds Lead Over 1933



Central-station energy output during the week ended February 17 continued the rate of gain over 1933 shown in the preceding week. The production of 1,640,951,000 kw.-hr., as announced by the Edison Electric Institute, was 11.6 per cent more than in the corresponding week last year and 6.2 more than the figure two years ago. The decrease from the week of February 10 was somewhat smaller than that usually occurring at this season of the year.

Output in New England has been gradually increasing its lead over 1933, which now amounts to 13.2 per cent. In the Middle Atlantic states the excess has for some weeks been around 12 and in the Central industrial area around 15 per cent. These ratios are being maintained, as is the gain of 8 per cent on the Coast. Slightly reduced gains appear in the South and West Central states.

Weekly Output, Millions of Kw.-Hr.

1934	1933	1932
Feb. 17...1,641	Feb. 18...1,470	Feb. 20...1,545
Feb. 10...1,652	Feb. 11...1,483	Feb. 13...1,579
Feb. 3...1,636	Feb. 4...1,455	Feb. 6...1,58
Jan. 27...1,611	Jan. 28...1,470	Jan. 30...1,58
Jan. 20...1,625	Jan. 21...1,484	Jan. 23...1,598

Per Cent Change from Previous Year

	Week ended		
Region	Feb. 17	Feb. 10	Feb. 3
New England	+13.2	+12.9	+11.8
Middle Atlantic	+12.1	+11.6	+12.3
Central Industrial	+15.4	+14.5	+16.6
West Central	+ 3.1	+ 4.6	+ 6.2
Southern States	+ 7.0	+10.0	+10.8
Rocky Mountain	+12.0	+ 8.9	+17.6
Pacific Coast	+ 8.9	+ 8.5	+ 8.6
United States	+11.6	+11.4	+12.5

Georges Claude to Build Ship Sea Power Plant

As a sequel to his but partially successful attempts to harness the sea in Cuban waters by the development of electrical energy from low-pressure turbines operated by sea water of different temperatures, Georges Claude, eminent French scientist and inventor, hopes to begin practical experiments again in the ocean off Brazil. After several weeks of taking ocean temperatures he plans to bring to the Brazilian coast a 10,000-ton laboratory ship now being remodeled and fitted to use as an ocean power plant to manufacture ice.

The ship will carry a tube more than 2,100 ft. long and about 7½ ft. in diameter, which will be suspended vertically in the sea and through which cold water will rise to drive low-pressure turbines. M. Claude's Cuban experiments resulted, after two failures in the placing of a pipe 1,500 meters long and about 6 ft. in diameter, in the production of a maximum of 20 kw. (ELECTRICAL WORLD, October 11, 1930, page 673). In 1932 (ELECTRICAL WORLD, June 11, page 1004) he reported perfecting of a device to improve the efficiency of his system.

106,000-Kw. Power Plant for the Transvaal

Construction will start shortly on a 106,000-kw. power plant at Meyertown, in the Transvaal, which will be South Africa's largest power station. The plant to be known as the Klip generating station, is planned to have a capacity 6,000 kw. more than that at Witbank, the country's present largest station, and will cost $5,000,000. The Electricity Control Board has yet to decide if the plant will be erected by Victoria Falls & Transvaal Power Company or the Electricity Supply Commission of South Africa.

In addition, a large expansion of existing distribution facilities will be required, including lines to the new Far West Rand goldfields, to be a chief customer.

P.W.A. Applications Halt; Few New Allotments Made

Due to an accumulation of applications for allotments of public works funds for non-federal projects which are still under examination, Secretary Ickes has halted submission of new non-federal projects and directed his administration to concentrate its effort on driving the vast total of work provided for in allotments already made into contract and into construction. The administrator cited the fact that a mighty "backlog" of non-federal projects already filed and under examination for which no allotments have been made has accumulated. There are over three and one-half billion dollars' worth of projects on file for which no allotments have been made and for which no money is immediately available because the original P.W.A. fund is exhausted.

Bonds for sale

After investigating the possibility of selling bonds acquired from municipalities and states as collateral for P.W.A. loans, Secretary Ickes announced that the new machinery had been set up to conduct the work. This decision of the Public Works Administration is in keeping with the government's policy of financing public works. When the government purchased the bonds to aid local governmental units in building of public works which the non-functioning private banking could not finance the government reserved the right to sell the securities it bought.

Allotments announced

The loan and grant of $436,000 to Florence, Ala., for the construction of an electrical distribution system, a 3,000-kva. central substation, feeder circuits from the government reservation at Muscle Shoals, etc., is a reallotment. The original loan and grant of $412,000 proved insufficient.

McPherson, Kan., was allotted a loan and grant for the sum of $211,000 for extending its municipal plant.

Brownsville, Tex., has been allotted a loan and grant of $200,000 for repairing damage done by the hurricane last fall to its electric light plant.

P.W.A. financing will make power available for many rural communities in South Carolina, according to an announcement made by D. B. Stover, Greenville, member of the state rural electrification board appointed by Governor Blackwood. Applications for nine rural electrification projects reaching more than 250 potential consumers have been recently filed with him.

Governor Brand of Maine has urged President Roosevelt to allocate $30,000,000 of public works funds for harnessing tides between Eastport and Lubec, Me., to provide a hydro-electric power development.

As to Rates——

• Indianapolis Power & Light Company's rates will be reduced further under the provisions of a petition that has been filed with the public service commission after the 8 per cent reduction (ELECTRICAL WORLD, February 10, page 239). It is believed the new petition will be consolidated with one already pending before the commission.

• Utah Power & Light Company, replying to the complaint of the Public Utilities Commission that its rates are excessive (ELECTRICAL WORLD, February 3, page 203), explained the average cost per kilowatt-hour for electric energy used for domestic and farm purposes in Utah had decreased 45 per cent since 1913, and that further reductions at this time would jeopardize the company's solvency. Among the vital considerations the company listed the following: Gross revenue has dropped from $11,144,861 in 1929 to $8,339,083 in 1933; taxes, excluding income taxes, have steadily increased until in 1933 they amounted to about one-sixth of the company's total operating revenues; the national average rate for residential and farm service is 19 per cent above the average on the company's system in Utah; the company's income has decreased to the point where it is far below a reasonable rate of return upon any reasonable value which might be assigned to its property.

• Western United Gas & Electric Company was charged with excess earnings from sale of electricity on the basis of the 6 per cent allowed profit before the Illinois Commerce Commission by Harry R. Booth, assistant attorney for the commission. He charged that the company, which was one of the 27 cited last March for reduction in rates, took in excess earnings of $4,000,000 within five years. The investigation has been conducted by the commission's technical staff. Exact figures will be produced, the lawyer said, when the hearings get under way.

• Duke Power Company made more money selling electricity last year at lower rates than it did in 1932 at its old rates, according to its annual report. Last year the company sold 74,000,000 more kilowatt-hours than in 1932, operating revenue increasing $809,497. The new rates, averaging a reduction of 5 per cent, became effective November, 1932.

Illinois valuation differences

• Public Service Company of Northern Illinois' rate hearing, continued last week before the commerce commission, brought out a disparity in appraisals of substation and power plant equipment investment. Professor Albert Richey, testifying for the company, placed a valuation of approximately $23,000,000 on the company's investment in substations and main plants. In earlier proceedings engineers of Day and Zimmermann, called as company witnesses, testified to value of approximately $30,000,000.

• Public Service Electric & Gas Company was charged with padding payrolls in order to increase the base on which electric light rates are fixed at a rate hearing last week. George Blake, general solicitor for the company, defied the commission to compel disclosure of the names on the payroll. The secret payroll was revealed when John A. Matthews, counsel for the utility users seeking a rate reduction, was questioning Ivan Gulick, auditor of the United Engineers & Constructors, Inc., 50 per cent of whose stock is owned by Public Service. It was brought out that the confidential payroll was allegedly used on a construction job at the West Orange switching station.

• Indiana Public Service Commission has announced that the success of a pay-as-you-go system of billing public utilities for work already completed on appraisals and audits by engineers has been established.

• Indiana Public Service Commission has been restrained from enforcing a rate cut at Rockport, Ind., by an interlocutory order issued by a three-judge federal court in Indianapolis. The suit tests the validity of the 1933 amendment to the Indiana utility law which forbids the commission to consider going value, good will and natural resources in the rate base.

Municipal Items

GRAND RAPIDS, MICH.—City commission has removed from the April 2 election ballot the proposition of whether municipally owned utilities shall be leased only upon a three-fifths vote of the electorate. The vote was to have been on a proposal to amend the charter, directed at renewal of the lease of the city lighting system to the Consumers Power Company. Commissioner Veldman, sponsor of the amendment, announced he would circulate an initiatory petition requiring the commission to submit the question to the voters.

EL PASO, TEX.—Request by a group of citizens that the question of construction and operation of a municipal electric light and power plant be submitted to qualified voters in March, when the election is held on the proposal to make a charge for sewer service, has been refused by Mayor R. E. Sherman. Water users and others in the proposed development of electric power at the Elephant Butte Dam and the Caballo Dam, which is to be constructed as an important link in the river rectification plan, saw an outlet for the power if the city would set up its own plant.

Rockford project delayed

ROCKFORD, IOWA. — Iowa Public Service Company is to take an appeal to the Circuit Court of Appeals from the decision made in United States District Court at Dubuque, wherein a contract for the construction of an electric light and power plant, to be municipally owned and operated, by the City Council of Rockford, and the Fairbanks-Morse Company, was found to be legal. The utility company, now holding a service franchise, sought to restrain officials from going ahead with construction contracts through injunction proceedings.

MOBERLY, MO.—Election will be held March 20 on a $700,000 bond issue to finance the construction of a municipal light and power plant and distribution system. The Federal Public Works Administration has already allotted $700,000 for the project. The improvements will include alterations and additions to the power plant building, installation of two 236-lb. boilers, two 2,000-kw. turbo-generators and auxiliary equipment and a complete electric distribution system.

MCCOOK, NEB. — Proposal to vote $250,000 in bonds for construction of a municipal light and power plant has been voted down by 1,070 to 693, a decisive vote for the home town of Senator George W. Norris. The federal government, over the protest of officials of the Nebraska Light & Power Company, which serves the city, had agreed to take the proposed bond issue as collateral security for a loan of like amount and also to make a $90,000 outright grant. Opponents of the bond issue argued that the investment is unnecessary because of the fact that the Sutherland public power project would supply current, as soon as developed, at less than the city could manufacture it.

MORRISTOWN, IND.—Construction of a municipal electric plant with a federal loan of approximately $50,000 has been voted by the citizens four to one. The town is now served by the Southeastern Indiana Power Company.

MONTREAL, QUE.—City Council has voted $200,000 to be used in improvements and extension of the electric system in the Westmount section.

WESTON, MO.—Voters have defeated a proposed $50,000 bond issue for a municipal light plant. City is served by the Missouri Gas & Electric Company under a franchise which expires in 1939.

FINANCIAL · · · BUSINESS

Scott Medals Awarded for Unit Air Conditioner

For their work in developing the De La Vergne air conditioner (ELECTRICAL WORLD, April 29, 1933, page 530) four engineers of Baldwin-Southwark Corporation have been awarded the John Scott medal for outstanding scientific achievement during the year 1933. Joining no less exalted company than that of Thomas A. Edison, Lee De Forest and Guglielmo Marconi, the prize winners, Charles R. Neeson, Harry L. Galson, Hans K. Steinfeld and Henry C. Heller, received medal certificates and checks for $500.

The trust making the awards has been administered since 1869 under the terms of the will of John Scott, chemist of Edinburgh, who bequeathed a sum of money to Philadelphia in 1816 to be used in making annual awards for the most outstanding scientific achievement of the year.

All-Industry Meeting Called on Code

RESULTS of the public hearing on proposed changes to the electrical manufacturing industry code held in Washington February 8 and subsequent conversations between the Washington authorities and the N.E.M.A. code committee have led to the calling of a meeting of the entire industry to consider changes in the basic code on March 1 in New York. Every firm in the industry is invited to send representatives, one of whom shall be empowered to vote. Each firm may send as many representatives as it desires, all of whom will be privileged to speak on any of the points to be brought up. Votes, however, will be cast only by the empowered representative, each company being entitled to only one vote on each question.

That the Washington authorities may have an index of the divisions of the industry's opinions on various points, each empowered voting representative, when registering, will deposit in sealed special envelopes which will be provided, data as to its total sales volume for 1933 and the average number of its employees for that year.

"Special" prices ruling

The question has occasionally arisen of late as to whether manufacturers were permitted to file prices for specific customers or for specific negotiations differing from their regular published price lists in order to meet competition or in order to secure certain specific negotiations. It is the opinion of N.E.M.A. counsel that this would be directly in opposition to the spirit and intent of the code, but possibly it might not be a violation of the code from a purely legal standpoint. The code committee has, therefore, ruled that "prices for special customers should not be permitted and that the standard prices, discounts and terms of sale as furnished by any manufacturer for his products should prevail until such time as he either revises or changes his price lists under the rules and in the manner prescribed by the code."

A temporary general code authority for the wholesaling or distributing trade has been designated by NRA. Donald Tolles of the National Electrical Wholesalers Association was appointed to represent the electrical division.

TO THE RIGHT

With the definite evidences of a swing toward conservatism on the part of the Administration, in spite of air mail scandals and stock exchange pillories, business has further encouragement to back up positive trade gains.

Business facts remain most hopeful. Energy production continues strong. Steel output passes 43 per cent on the upgrade. Lumber production improves. Bituminous coal output gains weekly and is well above that for a year ago. Freight car loadings up 1.5 per cent in a week and 13.4 per cent over last year. Automobile production holds close to 1933 peak week and exceeds all other intervals back to 1930 close.

Commodity prices continue to show notable strength. Security markets back and fill. Retail sales gain sharply. New volumes enter the capital goods markets largely in direct response to government spending but in part due to overdue natural recuperation.

Laclede Gets Extension on Much-Debated Loan

Extension of the controversial $10,000,000 refunding and extension mortgage 5 per cent gold bonds due April 1, 1934, of the Laclede Gas Light Company has been granted by the Missouri Public Service Commission for five years at 5½ per cent as the company requested. The commission held that "the extension is designed to make no change in the relative positions of any of the various classes of security holders with the exception of the common-stock holders, who must forego dividends until earned surplus of the corporation shall have been increased by three million dollars." The surplus as of December 31, 1933, was $4,005,494.

Previously the company withdrew its refunding bond offer (ELECTRICAL WORLD, January 20, page 134) after argument over its registration statement with the Federal Trade Commission that was filed under the securities act of 1933. Later it was rumored that the issue would be sold abroad, possibly in England.

It might seem overoptimistic even to think of twenty million American families living in twenty million complete electrical homes. But ten years ago it might have been considered just as overoptimistic to think of a man and his wife crossing the Atlantic twice within a few months, eastward and westward, by airplane.

EBEN G. CRAWFORD,
President
Cleveland Electric Illuminating Co.

Mr. Crawford recently pointed out that the goal can only be achieved by "persistent education, by intelligent salesmanship, and—perhaps this is most important—by the example which the men and women in the electrical industry can set through the use they make of electricity in their own homes."

Doherty Denies Tax Evasion

Replying to a charge made in Congress by Representative McFadden of Pennsylvania that he is "one of the biggest tax evaders in the nation," Henry L. Doherty, president of the Cities Service Company, stated his personal tax returns and those of the companies in which he is interested have always been carefully prepared by competent accountants and regular officers of the corporations. "The books and records of Cities Service Company and its subsidiaries," he said, "have been audited annually for years by independent public accountants. Financial statements have been filed with public bodies time without number. Every effort has been

made to see to it that proper accounting was made and the returns have been carefully checked by officials of the government . . ."

Portland Electric Offers New Bonds for Debentures

Holders of Pacific Northwest Public Service Company 6 per cent debentures due in 1950 have been notified by Franklin T. Griffith, president of Portland Electric Power Company (name since March, 1933), of the formulation of a plan whereby they may exchange their securities for an equal principal amount of 6 per cent collateral trust income bonds due in 1950. Under the terms approved by the Public Utilities Commissioner of Oregon, depositors would be entitled to receive for each $1,000 debenture an equal principal amount of the collateral trust bonds to mature March 1, 1950, and bearing interest at the same rate of 6 per cent payable semi-annually.

The new collateral trust bonds will be secured by deposit with the Guarantee Trust Company of New York, as trustee, of the entire capital stock of the Portland General Electric Company and Portland Traction Company except directors' qualifying shares. Interest will be paid only out of income of Portland Electric Power and will be cumulative from September 1, 1933. No dividends will be paid on stocks until all current and accumulated interest has been paid.

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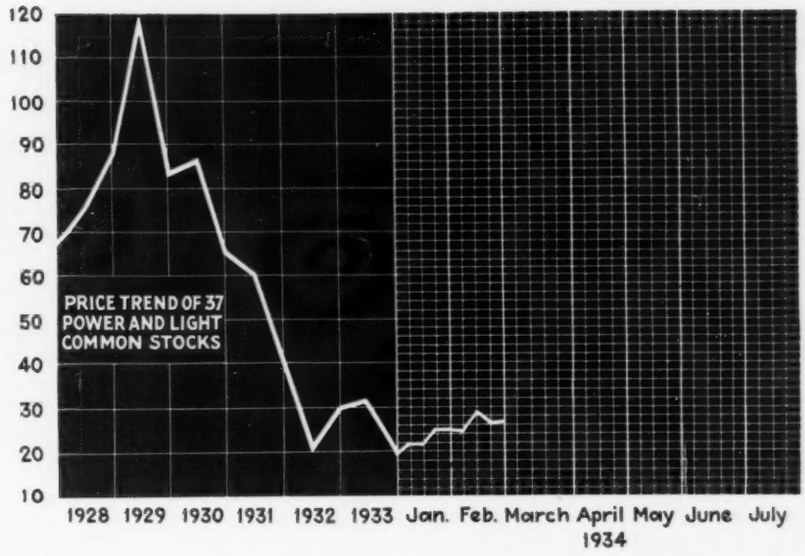
Saranac Power Plan

Holders of securities of the Saranac River Power Corporation are being urged to accept the offer of the Berst-Foster-Dixfield Company, sole consumer of the corporation's output of power, to purchase for cash all outstanding bonds and preferred and common stocks. Berst-Foster-Dixfield holds substantially all the $258,000 first mortgage 7 per cent bonds, a small part of the $282,000 first mortgage 6 per cent bonds and the majority of the common stock. It has offered $430 for each $1,000 of bonds, $12 a share for preferred stock and $1 a share for common stock. The offer, open until February 28, is conditioned on acceptance of the plan by holders of more than 75 per cent of the 6 per cent bonds and the majority of the preferred stock.

Baltimore Issue Planned

Application for the approval of the issuance of $1,100,000 of preferred stock, Series A, has been filed with the Maryland Public Service Commission by the Consolidated Gas, Electric Light & Power Company of Baltimore. A hearing will be held on the application on March 6.

Utility Stocks Little Changed



Along with the general market light and power common stocks fluctuated indecisively within a narrow range. Electrical World index 27.4; last week 27.0

Central States New Issues

In a registration statement filed with the Federal Trade Commission under the securities act, Central States Edison Company first lien bondholders' committee, having called for deposits of gold bonds and debentures of the company, seeks authority to issue fifteen-year first lien 5½ per cent gold bonds, series A, $1,919,000; 6 per cent gold debentures, series A, $840,000; two-year 6 per cent gold notes, $27,000, and unsecured obligations not exceeding $57,000. A new company is expected to be organized to acquire all the securities now pledged.

Niagara Unit Charged With Watered Capital

Books of the Niagara Falls Power Company reflected in 1918, at the time of its capitalization, $17,531,621 in "appreciation and watered capital on the books of the constituent companies," according to the testimony of M. C. Steele, an examiner, before the Federal Trade Commission at a hearing held last week. The company, formed by the consolidation of the Niagara Falls Power Company (old company), Cliff Electrical Distributing Company and Hydraulic Power Company of Niagara Falls, is the principal generating and wholesale distributing company of the Niagara Hudson Power system.

As to the earnings of the company, summary of the examiner's statement by the commission said: "The rates of return on average common stock equity on a corporate basis, that is, including only the stated value of common stock and surplus, as shown by the books of the Niagara Falls Power Company, in common stock equity, were 8.10 per cent for 1927; 13.01 for 1928; 13.43 per cent for 1929; 14.91 per cent for 1930, and 16.64 per cent for 1931. If the items of appreciation and watered stocks in the accounts of the constituent companies which are reflected in the accounts of the Niagara Falls Power Company as a result of the consolidation and adjustments of the latter's surplus were eliminated, the rates of return on average common stock equity on a corporate basis would be 122.63 per cent for 1927, 278.21 per cent for 1928, 265.80 per cent for 1929, 162.51 per cent for 1930 and 67.67 per cent for 1931."

Another write-up

According to Mr. Steele's summary the total capital stock of the Niagara Falls Power Company (consolidated company) at organization was $26,000,000, or $230,043.50 less than the aggregate book values of the capital stocks of the constituent companies. This amount was set up in a capital surplus account in the books of the consolidated company. "Therefore," the report says, "it is apparent that the books of the Niagara Falls Power Company (consolidated company) reflected the appreciation and watered capital on the books of the constituent companies amounting to $17,531,621. Likewise,

the fixed capital and investments of the consolidated company reflected the excess charges and appreciation on the books of the constituent companies in the same amount."

Fixed capital of the company at organization, as of October 1, 1918, amounted to $34,051,158, and as of December 31, 1931, had increased to $63,860,259. The increase of $29,809,101 was due largely to the construction of additional electrical generating units during the years 1918 to 1924.

Approved Cord Sales Jump to 75 Per Cent of Total

According to the Electrical Cord Manufacturers of the N.E.M.A., 1933 was the year of largest approved cord sales on record, as a result of the identified cord movement. In 1933, 417,077,000 ft. of approved flexible and 97,854,000 ft. of approved heater cords were produced, as compared with 287,414,000 ft. and 69,484,000 ft. respectively in 1932. The industry's previous peak was 1929, when 415,500,000 ft. of approved flexible cord and 68,600,000 ft. of heater cord were produced. Another fact, bearing out the success of the movement, is that whereas but 15 per cent of the cord sold in 1930 was approved by the National Board of Fire Underwriters and the International Association of Electrical Inspectors, today the figure is 75 per cent of all cord sold.

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Refrigerator Sales Up

Refrigerator shipments in January continued the gains shown in 1933. Movement from the Detroit plant of the Leonard Refrigerator Company exceeded by 175 per cent the total for January, 1933, to break all company records for that 30-day period. Likewise, the dollar volume for household electric refrigerators sold by Frigidaire Division of General Motors Corporation surpassed January, 1933, by 133 per cent, and commercial refrigeration sales were 43 per cent above for the same period. A 50 per cent production gain was also shown in January over 1933 at the Fort Wayne, Ind., works of the General Electric Company, of which the largest part was of refrigerators; this reflects the trend in sales of refrigeration of that company, which is in line with the movement.

New York Metal Prices

	Feb. 13, 1934 Cents per Pound	Feb. 20, 1934 Cents per Pound
Copper, electrolytic	8.00	8.00
Lead, Am. S. & R. price	4.00	4.00
Antimony	7.15	7.15
Nickel ingot	35.00	35.00
Zinc, spot	4.75	4.75
Tin, Straits	51.75	52.00
Aluminum, 99 per cent.	23.30	23.30

Electrical Supply Trade Shows Strong Uptrend

According to a recent report of Dun & Bradstreet, Inc., the electrical supply trade, with the exception of a few divisions, has made a more favorable start this year than in any other year in the past four. This trend really began in May and had advanced by the end of 1933 so that the trade had a gain in volume in 1933, for the first time in four years, of 10 per cent over 1932. Total approximate sales of appliances are placed at 739,000,000 units, as compared with 665,000,000 in 1932, or 0.1 per cent up. For the present year operations have gained by a growing percentage with each succeeding week, and production schedules have widened from 15 to 20 per cent over 1933. Sales in the last 90 days have been 20 to 35 per cent better than a year ago.

The general increase in supply business in 1933 is reflected in the Dun & Bradstreet figures for the failures in the electrical supply trade. There was a decline in number of failures from 209 in 1932 to 137, or 34.4 per cent, while the indebtedness involved dropped 49 per cent.

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Arrow-Hart Shows Profit

Reflecting the general improvement in the supply trade, the 1933 report of Arrow-Hart & Hegeman Electric Company shows income after taxes, depreciation and other charges of $17,228, equal to $1.06 a share on 16,206 6½ per cent preferred shares, excluding 4,877 treasury shares, contrasted with net loss of $169,623 in 1932. During 1933 a reserve of $24,146 for additional decline in marketable securities was charged against surplus.

Sangamo Cuts Losses

Net loss of the Sangamo Electric Company and subsidiaries for the year 1933 after interest, depreciation, minority interest, taxes, subsidiary preferred dividends and other charges totaled $63,655, again $263,931 lost in 1932.

Drought for Southeast

Hydro plants in the Southeastern states face during the balance of 1934 what are thought to be the poorest prospects ever encountered. Storage reservoirs of important systems in the Carolinas, Georgia, Alabama and Tennessee have been drawn down to their minimum flow lines. In the past these reservoirs usually have been filled between December 1 and the beginning of the plant growth season in the following spring. Three of these four months of the replenishment period have already passed and unprecedented rainfall is necessary during the few weeks left. Ample steam capacity has been installed since the 1925 drought to handle more than the demand that can be expected this year on the systems of the district.

Major New Construction This Week

Corning, Iowa, asks bids until March 12, for equipment for city-owned electric light and power plant, including three Diesel engine-generator units and complete electric distribution system. Fund of $160,000 available.

Lynchburg Distillery Company, Lynchburg, Ohio, plans $250,000 extension and improvements.

Heavy-duty motors, controls, regulators, electric welding equipment, electric hoists, etc., will be installed in $225,000 addition to plant of Steel & Tubes, Inc., Cleveland, Ohio.

Bids asked by Litchfield, Minn., until March 5, for new city-owned light and power plant.

Great Southern Alcohol Company, New Orleans, La., plans $80,000 plant.

Until March 1, United States Engineer Office, Kansas City, Mo., asks bids for one or two 154,000-kw. power substations for Fort Peck dam project, Missouri River, near Glasgow, Mont., to be used in connection with power supply from Rainbow generating station of Montana Power Company.

Shenandoah Brewing Company, Roanoke, Va., plans extensions and improvements to cost $100,000.

Transformers and accessories, motors and controls, electric hoists, conveyors, loaders and other equipment will be installed in new $125,000 mining plant of Shiawassee Coal Company, Ithaca, Mich.

Motors, controls, regulators, conveyors, etc., will be installed at linoleum plant of Sandura Company, Inc., Paulsboro, N. J., at cost of $250,000.

Vapor Lamps in Industry

At the Rugby, England, foundry of the British Thomson-Houston Company, Ltd., two main bays, each 240x32 ft., are now lighted by 24 400-watt gaseous-discharge lamps mounted on stanchions 17½ ft. above ground and 40 ft. apart. The minimum intensity of illumination is 3 foot-candles and the maximum 4.25. Energy use is 0.65 watt per square foot. The lamps are of a mercury-vapor type with wire cathodes inserted at each end of an inner glass tube, separated in turn from an outer glass envelope by an evacuated space. A wire spiral connected to the lower cathode adjusts the potential gradient along the tube at starting.

MEN OF THE INDUSTRY

Edgar Kobak Resigns

Edgar Kobak, a vice-president of the McGraw-Hill Publishing Company, Inc., since 1926, and for eighteen years associated with the publishers of ELECTRICAL WORLD, has resigned. Mr. Kobak, widely known in the electrical industry as a result of his diversified activities for McGraw-Hill in the course of his rise from subscription representative to vice-president, has not yet announced his future plans. Both as an editor and advertising salesman did Mr. Kobak early contribute to the progress of this publication. After two years as an assistant editor he joined the advertising and business division and as a salesman for ELECTRICAL WORLD and *Electrical Merchandising* covered the Chicago territory for two years; he spent one year in St. Louis in a similar capacity. Upon his return to the New York headquarters of the publishing company Mr. Kobak acted as promotion manager for ELECTRICAL WORLD before assuming a vice-presidency in McGraw-Hill. He served as sponsoring head for all the electrical papers of the organization in addition to being general sales manager of the company. He was a member of the executive committee and of the board of directors. He is widely known in advertising circles, being president of the Advertising Federation of America. Mr. Kobak, prior to entering the publishing business, was associated with the Georgia Railway & Power Company.

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F. E. HARRELL has been made assistant chief engineer of the Reliance Electric & Engineering Company, Cleveland. Mr. Harrell joined the Reliance organization upon graduation from Purdue University in 1924. Following sales engineering work in Chicago he returned to Cleveland as special engineer for steel-mill motor applications. He has since that time been chief draftsman and engineer in charge of alternating-current design.

CLARENCE A. MAYO has been appointed manager of the Eastern Massachusetts Electric Company, with headquarters at Salem. Mr. Mayo joined the Charles H. Tenney organization in 1911, entering the meter department of the Malden Electric Company; for three years he was superintendent of the Peoples Gas & Electric Company, Oswego, N. Y., and from 1916 to 1931 was electrical engineer of the Malden company. Following the death of the late A. T. Throop he became assistant manager of the Eastern Massachusetts company, which is the wholesaling and inter-connecting organization of the Tenney properties north of Boston, and now a part of the New England Power Association.

MARSHALL ADAMS, who has been sales promotion manager of the merchandising department of the Westinghouse Electric & Manufacturing Company, has been appointed sales promotion manager for the American Radiator Company. Except for a period in 1928, when he operated a retail refrigerator company, Mr. Adams has been connected with the Westinghouse organization since 1923.

JAMES H. PERKINS, chairman of the board of the National City Bank, has been elected a director of the New York Edison Company to fill the vacancy caused by the resignation of Charles E. Mitchell.

WILLIAM MCCLELLAN, president of the Potomac Electric Power Company, Washington, D. C., has been elected chairman of the finance committee of the American Engineering Council. Mr. McClellan, who is a fellow and past-president of the American Institute of Electrical Engineers, is a representative of that society on the American Engineering Council Assembly.

PIERCE J. KENT, chief system operator of the Edison Electric Illuminating Company of Boston, and widely known in the eastern central station field for his activities in connection with the New England System Operators Club and handling of local and interchange facilities in eastern Massachusetts, will retire on March 1 after 47 years of service with the Boston company.

OWEN D. YOUNG, chairman of the board of directors of the General Electric Company, was formally elected a member of the New York State Board of Regents last week.

JOHN H. HUBBS has been appointed purchasing agent of the United Gas Improvement Company. Having served as assistant purchasing agent of the company for a number of years, and with his intimate knowledge of materials and markets, Mr. Hubbs is eminently fitted for his new position.

H. G. PERKINS has been made a vice-president of Kelvinator Corporation following a five years' association with that organization. Mr. Perkins became identified with Kelvinator in 1929 after fifteen years of varied industrial experience.

F. E. BOYD, vice-president and general manager of the Pacific Electric Motor Works, Oakland, Calif., has been elected president of the newly formed Electrical Contractors Association of Alameda County.

OBITUARY

Harry T. Edgar

Harry T. Edgar, for 32 years associated with Stone & Webster in public utility management in the west, south and New England headquarters office at Boston, until his retirement in 1931, died at his home in Sherburn, Mass., on Feb. 15 after a week's illness. Mr. Edgar was a native of Griggstown, N. J.; his early career included service with the Edison company of New Brunswick, N. J., Edison Electric Light Company of New York (a General Electric predecessor), and the Georgia Electric Light Company of Atlanta. From 1897 to 1899 he was in the electrical apparatus sales field in New York and New England. He joined Stone & Webster in 1899 and later was manager of the central stations at Lowell, Mass.; El Paso, Tex.; Fort Worth, Tex., and Seattle, Wash. From 1912 until his retirement he was district manager of properties in Michigan, Iowa and Kentucky for this house, with offices at Boston. He was a brother of the late Charles L. Edgar, president of the Boston Edison Company.

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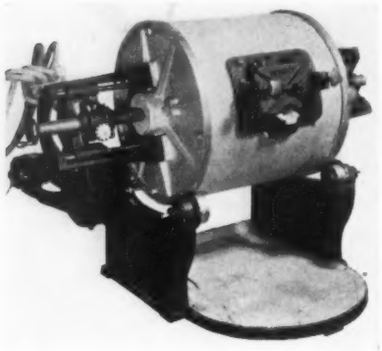
WILLIAM E. HUMPHREY, former Federal Trade Commissioner, who was removed by President Roosevelt, died suddenly February 14 as the result of a stroke. He was 71 years of age. The President's action last fall in removing Mr. Humphrey as a member of the Trade Commission (ELECTRICAL WORLD, October 14, page 483) stirred a bitter controversy and formed the basis of a suit filed by Mr. Humphrey in the Court of Claims in Washington to contest Mr. Roosevelt's authority and to collect back salary. A native of Indiana, Mr. Humphrey was a member of Congress from Washington from 1902 until 1917. After his service in Congress he practiced law in Washington and in Seattle until 1925, when he was appointed to the commission by President Coolidge for a six-year term. He was named again in 1931 by President Hoover for another six-year term.

NEW EQUIPMENT

Small Rocking Furnaces

Rocking electric furnaces of 25 to 100 lb. capacity have been announced by the Detroit Electric Furnace Company of Detroit for either production or experimental melting of small lot runs of metals, such as iron, alloy steel, copper, brass, nickel, aluminum or precious metals. Except for size, the furnace is a faithful reproduction of the larger rocking electric furnaces and will provide the speed, economy and analysis control for which these furnaces are well known. They are completely equipped with transformer, control panel, switches, meters and rocking mechanism, have a nominal electrical rating of 20 kw. and may be connected to any industrial power supply.



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INDICATING POTENTIOMETER PYROMETERS with all adjustments on front cover plate are announced by the Foxboro Company, Foxboro, Mass. They are mounted in a moisture-proof case for surface or flush mounting. The double-suspension galvanometer employed is designed to withstand rough industrial use. Multiple-point rotary selector switches enable use of indicator for temperature readings from any number of thermocouples located at scattered points; switches are simple in design and can also be furnished for flush or panel mounting. The temperature scale on the 6-in. dial is 17 in. long and permits accurate reading.

SWITCHES, RECEPTACLES AND PILOT LIGHT combinations of its "Timesaver" line have been announced by the Arrow Electric Division of the Arrow-Hart & Hegeman Electric Company of Hartford. The line stresses compact design, all-bakelite bases and the mechanism is fully inclosed and sealed, making a dust-proof switch. Switches, receptacles and pilot light combinations come all assembled in one base; switches are designed specifically for modern type C lamp loads. Single-pole, double-pole and three- and four-way switches are all available in combinations.

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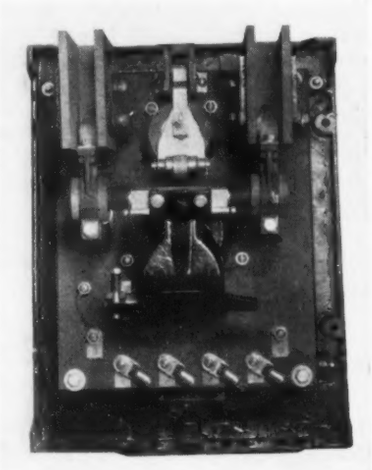
SEALED-TYPE MERCURY THERMAL REGULATORS that may be easily and accurately set at operating temperatures without trial and error have been introduced by the American Instrument Company, Washington, D. C. The regulators are intended for use with any relay that does not use more than 10 milliamp. operative current. To set, bulb is immersed in liquid of temperature at which regulator is to be set and time is allowed for regulator to come up to temperature and surplus mercury is spilled off into a side reservoir by a quick tipping motion. This method permits setting within 0.02 deg. C. and sensitivity is plus or minus 0.01 deg. C. or better. The setting is unaffected by a 20-deg. overshoot in temperature.

Arc-Suppressing Controllers

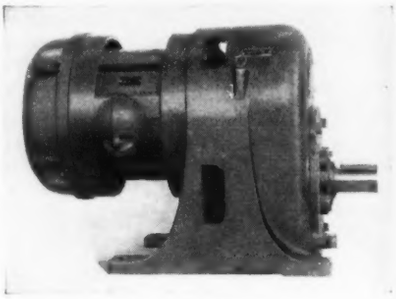
Lifting magnet controllers, provided with arc suppressors so that contact wear is small, have been introduced by the Ohio Electric Manufacturing Company of Cleveland to replace its former magnet control. The controllers, provided with either lever type or push-button type masters, have the main magnetic circuit opened by the two main switches in series; the reverse circuit is opened by the small magnetic switch in the center. The master contacts carry control circuits only. Arc shields are cut from Lavite cured at high temperature, which the arc cannot cut or burn.



The arc suppressor, the addition of which raised the weight of the main controller to 136 lb. from the former weight of 98 lb., absorbs the voltage caused by induction when the magnet circuit is opened so that the arc at the main switch is only the small arc caused by breaking the line voltage and is not harmful to contact tips and arc shields. The suppressor is located back of the control panel and is always connected across the magnet terminals.

Single-Reduction Gearmotors

Gearmotors, identified as single-reduction type S, have recently been offered by the Reliance Electric & Engineering Company of Cleveland. These are used for ratios up to 6:1 inclusive and can be furnished with either a.c. or d.c. motors of different types and rated ¼ hp. and up. The entire reduction is obtained in a single pair of gears. Solid support close to the point of maximum torque is afforded by having the feet under and cast integral with the gear housing. Space requirement is small and motor parts and gears can be readily removed and assembled; gear ratio can be changed by substituting a different pinion.



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SERVICE ENTRANCE CABLE, thoroughly armored, weatherproof in construction and durable in every climate, has been introduced by the General Electric Company as G-E AEIC type. Conductivity is improved by new engineering features: Stranded conductors covered with rubber insulation and moisture-proof cotton braid; stranded bare conductor, concentrically wound and equally applied, is immediately covered by the metal armor; this armor is protected with a double overlapping wrap of rubber tape, with asphalt barriers, and by a heavy flame and weather-proof cotton braid. The cable is extremely flexible and easy to work and affords maximum protection.